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This study was conducted to explore the ability of children (6 to 12 years of age) to understand certain relatively complex relationships as they are commonly signaled syntactically in our language. It was hypothesized that development in language performance during this age range was, in some measure, a function of a growing ability to comprehend the precise meaning of a variety of structural signals and to produce them in appropriate situations. Four such signals and the ability of 20 boys (ages 7, 9, and 11 years) to understand them were studied (1) simple active-declarative utterances, (2) utterances involving complex logical relations, (3) special verb-indirect object relation utterances, and (4) utterances involving complex subject-verb-object relations. Little difficulty was experienced by any age group with simple statements, affirmative conditionals, and embedded sentences. Limiting contingencies with "although" and "but" and negative conditionals with "if" and "not" were more difficult, with performance improving with age. "Ask-tell" combination utterances and negative conditionals with "unless" were very difficult, especially for the 7- and 9-year-olds. Game instructions and a bibliography are included in the document. (WD)

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Report Number 4

AN EXPERIMENTAL STUDY OF SYNTACTICAL FACTORS INFLUENCING CHILDREN'S COMPREHENSION OF CERTAIN COMPLEX RELATIONSHIPS

Henry F. Olds, Jr.

Center for Research and Development on
Educational Differences

Harvard University
Cambridge, Massachusetts

1968

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This Final Report describes one aspect of the work of the Center's School Language Group.

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It is not possible to express the extent of my gratitude to my wife and colleague, Anita. Her wisdom, understanding, and love made it possible.

Henry Olds

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ABSTRACT

The research reported in this study explored the growth in children's comprehension of certain complex relationships as they are signaled syntactically in our language. It was assumed that development in language performance is, in large part, a function of a growing ability to comprehend and produce structures that signal relations. The comprehension of four general types of relations, each signaled by different syntactic structures, was studied: 1) simple relations; 2) complex logical relations, signaled by certain logical connectors; 3) a special verb-indirect object relation, signaled by a WH-question word and somewhat confounded by the absence of pronominal identification; 4) and complex subject-verb-object relations, signaled by relative pronouns.

Twenty boys from each of three age levels, 7, 9, and 11, with average I.Q.'s were tested. The testing instrument was a checker-like game, specifically developed for this study, which children played by interpreting instructions of various kinds that had been pre-recorded on tape-cards. The game was used as a testing instrument because it provided a reasonably natural language situation and a high level of motivation, and it reduced semantic variation to a minimum. Sample instructions from each of the four types noted above were: 1) You may move a circle one space. 2) If you have a diamond, you may move a triangle one space. 3) Ask your opponent which piece to move one space. 4) The piece that your opponent just moved may be moved two spaces backwards.

As the children played the game, their correct and incorrect responses were noted, and the latencies of their responses to each instruction were measured. Observational notes and tape recordings were made of verbal interchanges that took place during the game.

Results are presented which indicate an increasing ability to comprehend the various types of structures employed with increasing age. Over all subjects, simple statements, affirmative conditionals with "if," and self-embedded utterances proved extremely easy. Negative conditionals with "if + not," temporal contingencies with "after," "before," "when," and "as soon as," and limiting contingencies with "although" and "but" proved somewhat more difficult. Negative conditionals with "unless" and utterances involving a distinction between "ask" and "tell" proved extremely difficult.

On several types of structures there was evidence of learning during the course of the game, and an analysis of the influence of one player on the other showed that on some structures children were able to instruct each other, but on others instruction was of little value.

The results suggest that there are two aspects of language development between the ages of 6 and 12 that merit

further study: a limited set of special signaling devices, of which the logical connectors form a major part, that serve to enhance communication; and the expanding semantic system which, as it develops, increases the ability of the child to make finer semantic differentiations.

CHAPTER I

INTRODUCTION AND BACKGROUND

General Introduction

When the term "psycholinguistics" was coined about fifteen years ago there was considerable optimism that collaboration between linguists and psychologists would answer many of the unanswered questions about the nature of language, how language is learned, and the relationship between language and thought. Structural linguists, who had developed techniques for describing formerly unknown languages, began applying similar techniques to known languages in an attempt to gain deeper insight into their structures. Concurrently, behavioral psychologists, who had developed a schema for describing the behavior of animals under controlled laboratory conditions, began focusing their attention upon the complexities of human behavior in an attempt to reduce them to manageable proportions. The joining of forces of these two fields to try to unravel the mysteries of man's most peculiarly human form of behavior seemed to hold great promise.

Those psycholinguists who had studied the growth of children's language ability recognized that a child's ability to use language is well developed by age 6. In his review in 1960 of research on language development Carroll notes:

> Language development is rapid in all respects. By the age of about six, the average child has mastered nearly all the phonemic distinctions of his language, and practically all its common grammatical forms and constructions -- at least those used by the adults and older children in his environment. After the age of six there is relatively little in the grammar or syntax of the language that the average child needs to learn (except to achieve a school-imposed standard of speech or writing to which he may not be accustomed in his home environment). (p. 338)

While this statement represented a consensus of opinion, it evoked at the time little surprise or curiosity among psycholinguists about how such a level of accomplishment might be attained. They widely assumed on the basis of the structural linguists' descriptions of language that the learning task of the child is not unduly difficult and that he learns his native language in a relatively straightforward manner that could be sufficiently explained on the basis of a small set of learning principles proposed by behavioral psychologists.

The publication in 1957 of Skinner's *Verbal Behavior* offered a definitive statement of behavioral principles and appeared to provide a sound basis for research on language learning that would yield revealing results in a relatively short time. However, one serious dissent served to muddy what were apparently clear waters. For in the same year the publication of Chomsky's *Syntactic*

Structures indicated that there existed sharply differing views among linguists on the structure of language and on the most productive approach to describing that structure. At the time this book was published few psycholinguists realized that the implications of the approach to language structure taken by Chomsky extended well beyond linguistics to the heart of the behaviorist's assumptions both about behavior in general and about verbal behavior in particular. Subsequently, with the publication in 1959 of Chomsky's review of Verbal Behavior the issues became more clearly drawn, and psycholinguists found themselves involved in trying to understand deeper mysteries about language that could be explained adequately only by the creation of far more powerful and complex theories.

Chomsky emphasized that the most important aspects of a person's knowledge of his language cannot be explained sufficiently by observing and classifying only his language behavior. The creative capacity of a language, that capacity a person has for constantly uttering novel sentences, sentences that he has never before heard or spoken, cannot be accounted for if one's explanation is limited to a relatively small number of observed utterances. The generative-transformational analysis for the syntax of language that Chomsky proposed attempted both to account for the observed facts of language behavior and to explain them within the framework of a theory of language that might account in some reasonable way for the creativity of the system as well as for a speaker's intuitive sense of such linguistic conditions as ambiguity, grammaticalness, etc.

According to Chomsky's theory, the child of 6 who has learned his language is not merely able to use it well, but also has internalized a complete knowledge of the structure or rules of the language. Though his vocabulary may be limited by his knowledge of the world, he can employ the structural resources of the language to generate an infinite number of novel utterances. Furthermore, the child attains this knowledge in a relatively short time, with no obvious formal tutelage on the part of adults, and before he is able to learn even the simplest of logical operations. Partly because of this deepened awareness of the linguistic accomplishments of the child, considerable thought and research in psycholinguistics has recently been devoted to understanding the process of language acquisition.

However, very little thought has been given to how language development proceeds after the point at which it can be safely assumed that the child knows his language. A 6 year old child can hardly be considered an accomplished language performer. He has only begun to develop those abilities (perhaps we could call them strategies) that he must learn in order to use his knowledge of language as an efficient communication device and to become a mature speaker of the language. Just as it is clear that a 6 year old child can speak and understand an almost infinite variety of sentences in his language, it is also clear that a 12 year old child can effectively express and understand a vast range of relationships that can be signaled through his language. Therefore, an assumption of the research reported here, an assumption which also underlies all language arts instruction in elementary schools, is that there is a significant growth in verbal ability between the ages of 6 and 12. Furthermore, it is felt that this growth is a necessary and integral part of language development and not, as suggested above in the quotation from Carroll, merely "to achieve a school-imposed standard of speech or writing to which he may not be accustomed in his home environment."

This study is not intended as an empirical test of a well motivated theory of late language development, for no theory of this kind presently exists. Nor is the study intended to include all the possible aspects of development that would have to be considered in an adequate theory. In fact, the goal of this study is quite modest and highly circumscribed. It attempts to take a close look at a narrow range of utterance types that were selected mainly on the basis of the investigator's hunches that they might

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prove revealing of certain aspects of verbal growth between the ages of 6 and 12. More specific reasons for this selection will be given in Chapter II. In addition, the study attempts to show the value of a particular methodology for investigating verbal growth. Since what any researcher can learn about language is often highly dependent upon the instrument he develops for his study, it is hoped that the instrument and methodology chosen and developed for this study, which are unique in certain respects, may prove effective devices for other studies of language behavior.

Before describing in detail the specific aspects of language development that were examined in this research, it may be valuable to look at a few types of psycholinguistic studies that have been carried out in the past decade, as well as at a few earlier studies of language growth that are particularly pertinent to the present research. Just as the brief simplified outline of recent psycholinguistic history given above was intended merely to place all recent psycholinguistic research in some general perspective, the discussion which follows is intended to give a perspective within which the present study can be seen and is not to be taken as an exhaustive review of all the relevant literature.

Studies of Natural Productions

By far the greatest number of studies of language development have been studies of production. Generally speaking, these studies have sampled language behavior at various points in the child's development and then have subjected the data to various measuring devices and methods of classification. The goal of these studies has been to provide a picture of what verbal development looks like from its beginnings to its full development. However, despite a large number of fairly elaborate investigations, the picture has remained fuzzy and vague.

The early studies of LaBrant (1933), Davis (1938), Smith (1944), Harrell (1957), and Templin (1957) have recently been supplemented by the slightly more refined studies of Strickland (1962), Menyuk (1963a), Loban (1963, 1966), Hunt (1965) and O'Donnell, Griffin and Norris (1967). We know from these studies that as children get older, the average length of their utterances increases. Both Hunt, who studied only writing, and O'Donnell _et al._, who studied both writing and speech, have found that the difference in utterance length between immature and mature children is attributable to a decrease in the number of very short utterances and an increase in comparatively long utterances, the number of average length utterances remaining about the same. While it is valuable to have a quantitative index of verbal development, the amount of effort that has been devoted to developing greater precision for such an index seems out of proportion to its value in helping to explain verbal development. Constant refinements of such an obvious indicator of growth may, as Hunt himself suggests (1965, p. 48), be of diminishing value:

> Sentence length is indeed a significant index of maturity, but it is statistically less significant than at least three others which have been examined so far in this study. Any competent grammarian should find T-unit length or clause length or subordination ratio to be "objective," "quantitative," and "reliable," though indeed not so "easily determined" as sentence length.

In order to give a more qualitative picture of language development, studies of language production have also made elaborate classifications of language structures and have reported the percent occurrence of particular structures in the language samples of children at various stages of development. Although recent studies have used more refined classification schemes to supplement and further elaborate the findings of early studies, and although they have made strong claims for the advantage provided them by adopting a particular grammar in making such classifications, the resulting information does not seem to justify the efforts, nor does it warrant the claim that the adoption of any one type of grammatical analysis leads to a greater sensitivity in classification procedures. The names of the structures may be changed, but the resulting classifications seem to be fairly comparable across studies.

The purpose of classifying linguistic forms (e.g. various types of clauses, their functions, and the words that introduce them) and recording their frequency of occurrence in children's language is to find out what particular constructions contribute most significantly to the ability of older children to say more in each utterance unit. Unfortunately, in most studies the majority of constructions classified show virtually no change in frequency of occurrence over the ages studied. For example, in the study of O'Donnell *et al*. the authors admit that their findings bearing on the sequential enlargement of syntactic repertoires are inconclusive. Furthermore, when changes are found, they are often more puzzling than enlightening. For example, it is difficult to explain why, in the study noted above, kindergarten children use more relative clauses than children in grade seven.

Studies of production have certainly made some valuable contributions to our knowledge of language growth. For example, Hunt's T-unit does seem a more reliable index of language growth than those used by prior investigators. O'Donnell *et al*. have suggested that language development may not proceed in a linear fashion but may occur in several spurts, one of which occurs at about age 6, another at age 11 or 12. And Loban's qualitative finding that children who had the greatest language power by all measures were also those who most frequently used language to express tentativeness suggests a specific developing ability that might be explored in greater detail.

However, there are a vast number of inherent limitations to studies of production of this kind. The range of speech situations that can be sampled must necessarily be only a very small proportion of those which are possible. Loban, for instance, used a structured interview situation where children were asked to describe a set of pictures. O'Donnell *et al*. asked the children to tell the story of a film that they had just seen. It is rather obvious that a child's way of talking in such circumstances will depend to a very large extent on the particular type of talk that is demanded of him. Furthermore, his manner of speaking in front of an adult interviewer is liable to be only one of the many modes of conversation that he is learning to master.

It should not be surprising that, as noted above, reporting the percent occurrence of various structures, no matter how elaborately classified, is not very informative. There is really little reason to suspect that it would be, for as all the studies indicate, children in the age range of 5-12 produce virtually all of the classified structures at all ages. Though there is a tendency shown for some types of structures to increase gradually, sometimes even significantly, with age in relation to other structures, there clearly exists an overall relationship among structures in the language that is probably more heavily reflected in any percentage figure than the specific stage of development of an individual or group of children. In other words, if one classifies all the structures of English according to some system, then for any sizable sample of English utterances there will be a percent occurrence figure for each structure that will remain fairly stable over samples of utterances taken under similar conditions. The stability of this relationship among structures is very likely to overshadow by far attempts to measure differences, and therefore any indicators of real differences are very likely to be obscured. McCarthy (1946) criticized early studies of this type on exactly these grounds, and her criticism applies well to more recent research:

> So many of the analyses to which language development has been subjected, particularly the structural, functional, and parts-of-speech analyses, involve classification into percentages within a closed system that relationships can only be inferred from some of the shifts which occur in the percentages. One change or trend in such a system inevitably affects the other proportions, since all figures are relative. The result is that, upon completion of any one type of analysis, a set of values is obtained rather than a single index of the child's level of sentence structure or some other measure which can be correlated with other indices. (pp. 542-543)

An alternative method of studying language development through children's productions has been to conduct close analyses of the development of individual children over time. Since Loban's study (1963, 1966) involves a single large group of children studied over successive years, one would hope that some aspects of individual growth might be discovered during the course of his research. But so far reports have compared the total group at one age with the total group at another age, and therefore are subject to the reservations expressed above about such comparisons. Furthermore, since Loban is attempting to study a large number of children, it seems doubtful that he will be able to gather enough information on individuals to make analysis of individual growth very revealing.

The value of longitudinal studies of language development of individual children depends upon the thoroughness of the study and the cleverness of the researcher. A very large sampling of the individual's speech production must be gathered over an extended period of time and in a wide variety of language situations. Furthermore, researchers have often found it desirable to construct situations to elicit productions when they have felt that it might prove to be revealing of certain aspects of development. The most thorough and exhaustive study of this type has been conducted with three children by Roger Brown and his associates (e.g. Brown and Fraser, 1963, Brown and Bellugi, 1964), and similar studies have been conducted by Braine (1963) and Miller and Ervin (1964). Notably, these studies have concentrated upon the early stages of language acquisition (from 2 to 5 years), because the older the child, the more data is necessary to adequately represent his stage of development at any one point. Since it seems unlikely that it would be feasible to study a child's language development between the ages of 6 and 12 in the intensive manner Brown has employed, alternative procedures need to be found for the study of older children. The research reported here is an attempt to suggest at least one such alternative.

However, working with very young children, while limiting somewhat the range of language behavior that must be accounted for, poses theoretical and methodological problems of its own. As has often been noted, in studying the language of an adult or even a 6 year old child, one can often find out what the individual means by something he has said by asking him directly or by questioning him indirectly. Very young children, however, are notoriously enigmatic, and direct attempts to elicit clarifying verbal responses are usually unsuccessful. When a young child says, "Brown doggie," it is often not an easy matter to decide if he is making a statement about the color of the dog, if he is telling you to look at the dog, if he is naming the four-legged animal in the room, if he is calling the dog, etc. Furthermore, since very young children's utterances tend to differ substantially from well-formed adult utterances, it is not an easy matter to decide when an utterance is well-formed for the child. Though a number of theoretical objections have been raised to the methods used in longitudinal studies for describing children's productions (e.g. Chomsky, 1964 and Lees, 1964), the attempts that have been made to write "grammars" for children at various stages of development are certainly laudable, particularly when viewed as a set of hypotheses about the child's ability, to be explored further with other children in other contexts. In some cases very close study of a particular linguistic form as it emerges in the records of a child's language growth will yield insights into how language comes to be. The recent work of Bellugi (1967) on the system of negation and of Cazden (1967) on noun and verb inflections would indicate that close analysis of longitudinal data may provide even more interesting hypotheses about language development than emerge from a series of "grammars."

Studies of Elicited Productions

In some sense all studies of verbal behavior are studies of elicited verbal behavior. Loban elicited verbal responses with pictures, O'Donnell *et al*. asked children to tell the story of a film, and longitudinal studies have often attempted to elicit particular types of responses from the children under observation. However, in this section we will consider a few studies that have systematically employed specific techniques for eliciting particular aspects of verbal behavior in order to understand more fully a child's verbal ability at a particular point in his development.

Berko's study (1958) of the child's learning of English morphology is prototypical of this type of research. Her study concentrated on the system of rules governing the use of inflexional suffixes that a child must learn in order to make such distinctions as singular-plural, present-past tense, etc. To test children's ability to use these rules productively in novel situations, Berko designed a set of materials that asked the child to provide appropriate inflections for nonsense words. For example, the child was shown a picture of an imaginary creature and told, "This is a wug." Then he was shown a picture of two of the creatures and told, "Now there is another one. There are two of them. There are two _______." The child's task was to fill in the appropriately inflected form of the nonsense word and thereby to indicate his ability to apply a set of productive rules that are highly general in the language. Among the children studied (preschoolers and first graders), a generally high level of ability was found for most items. On about half the items a significant difference in performance between the two groups was found. But, the most significant contribution of this study was the clear demonstration it provided of a rule-governed aspect of language that has been fairly well internalized by the 5 or 6 year old child. Berko's technique of eliciting responses from children seemed to hold much promise for studying additional aspects of language development, but unfortunately there are not very many pieces of the language system that can be abstracted quite so easily from the system as a whole in order to test a speaker's productive ability.

A different approach to the elicitation of verbal behavior in children has been adopted in several recent studies. Despite skepticism about the role that imitation plays in the process of a child's learning his language, there has been some interest in studying the child's ability to imitate for whatever light it might shed on the degree of control he exercises over his language. Implicit in studies of imitation is the assumption that to imitate a sentence in the language involves mental operations of a different order than would be involved in sheer mimicry. Some species of birds and all humans have the capacity to mimic patterns of vocal sounds that are fairly long and complex. But only humans have the capacity to speak an infinite number of utterances that are identical in all respects critical for understanding to a previously spoken utterance. Whereas it cannot be denied that a human being, when asked to imitate a sentence of his language, merely mimics the sounds he hears, it seems reasonable to assume that he may do more than that -- that he may in fact be making full or at least partial use of his language speaking capabilities in performing such a task.

Fraser, Bellugi and Brown (1963) designed a test for eliciting verbal behavior from 3 year old children which included three comparable language tasks, one of which was an imitation task. Ten grammatical contrasts were chosen, partly because previous longitudinal studies had indicated that children did not produce them and partly because they could be depicted pictorially. A grammatical contrast was defined as occurring when two sentences differed in a single grammatical feature. The children were asked to process the sentences in three different ways: by imitating the sentence (Imitation), by pointing to a picture corresponding to the meaning conveyed by the sentence (Comprehension), and by pointing to a picture and producing the appropriate sentence describing the picture (Production). On the basis of the contrasts studied and the particular tasks as defined, it was found that Imitation was easier than both Comprehension and Production and that Comprehension was easier than Production. More interesting than this finding was the indication provided by this study that the combination of the three tasks (ICP) might be a valuable methodology for intensive investigation of grammatical development of children. For example, it was discovered that the subjects in this study tended to interpret the subject-object relationship in a passive sentence as if it were an active sentence, suggesting incomplete mastery of ability to interpret passive English sentences at age 3.

The Imitation task, looked at across the ten grammatical contrasts used in this study, did provide some information about the children's ability. Because the Imitation task proved to be always easier, with one exception, than the other two tasks, the authors claimed that Imitation is merely a perceptual-motor skill not dependent on comprehension. Yet the data also showed that the scores on the Imitation task varied directly with the scores on the other two tasks, a finding that suggests that whatever aspect of structure caused difficulty on the Comprehension task also caused difficulty, but to a lesser degree, on the Imitation task. It is reasonable to claim, therefore, that the Imitation task and the Comprehension task both make demands upon an aspect of language ability, call it interpretation, that might be studied by the use of both tasks. In any case, relegating Imitation to the realm of perceptual-motor skills serves only to beg the important question of how a child does imitate an English sentence. Had the authors provided specific examples of the imitation errors made by the children,some light might have been shed on this question.

A more intensive study of children's language abilities that used imitation as an eliciting technique was carried out by Menyuk (1963b). Selecting her sentence types on the basis of a previous study of children's productions (1963a), she asked nursery school and kindergarten children to imitate both fully well-formed English sentences and a large number of "restricted" forms (forms children had produced that deviated in some way from fully well-formed utterances). Her results showed that there was no well-formed type that was not repeated by a significant number of children. Furthermore, within the bounds of two to nine word sentences, success in repetition was not dependent upon the length of the sentence but upon the nature of the particular rules involved in generating the sentence. More interesting was the finding that only 13 of the 31 "restricted" forms were repeated by a significant number of nursery school children and that most of the nonrepetitions consisted of the children's correcting the restricted form to make it well-formed. Where failures in repetition did occur for well-formed sentences, they did not appear to be random but could be accounted for on the basis of what seemed to be the application of less sophisticated grammatical rules. The study suggests that in the process of repeating (imitating) an English sentence, children do bring to bear on the task their capability to use language and that therefore imitation may be a valuable method for assessing language development. Also, the study showed that imitation can be used effectively to explore the extent to which the production of "restricted" forms by a child is in fact a true indication of his ability to correctly process these forms. If a child is capable of correcting his own errors when given the opportunity, then it is likely that they are merely errors and not indications of underlying and more general deficiencies in his system of rules for generating language.

Imitation has also been used by Slobin and Welsh (1967) to look at the language ability of one very young child (2 years). Once again it seems clear that the errors that a child makes in trying to repeat a sentence are not random but are directly indicative of his ability to process a sentence. Though their account of a single child's repetitions of a variety of structures is at best thought provoking, they demonstrate that the technique can well be applied more generally to very young children with potentially interesting results.

One variation on the basic imitation technique has been employed by Rui (1967). She asked children to "model" certain types of structures to see if they fully controlled the ability to transform one version of an utterance into another version of the utterance. Two experimenters modeled a particular transformation for the child until the child seemed to understand what was required. Then one of the experimenters would say one form (e.g. "The dog bit the boy."), and the child would be asked to supply the variant form (e.g. "The boy was bit by the dog."). Several transformation types were used to see if differences in performance could be found between middle class and lower class children. Though the results were inconclusive, the modeling technique seems to merit consideration, particularly when studying children beyond the age where the use of imitation is likely to be informative.

In summary, it can be said that using imitation as a technique for eliciting verbal responses shows considerable promise, particularly when applied to very young children (below the age of 4). In fact, it may be the only available technique for getting such young children to make what amount to "grammatical judgments." However, the value of the technique undoubtedly decreases drastically with children much beyond the age of 5 who are largely in control of their language. Complicating the imitation task by masking the stimulus sentence with noise or by introducing delay before the subject's response may be techniques that could be used with older children as they have been used in perception and recall studies with adults (e.g. Miller and Isard, 1963, Savin and Perchonock, 1965).

Studies of Comprehension

Miller (1964) notes that there are at least six different things a listener can do with a spoken utterance that psycholinguistics might hope to explain: he hears it, he matches it with his phonological system, he accepts it as a structurally well-formed utterance, he provides an interpretation of the utterance, he understands it largely on the basis of contextual information surrounding it, and he believes it (makes value judgments about it) on the basis of his own relationship to it. Though each of these operations merits study in its own right, the fourth -- the process of interpreting an utterance -- has been of particular interest in recent research and still remains largely unexplained. In fact, in 1962 Miller himself argued strongly for psycholinguistics to focus its study upon the process of comprehension, rather than on the processes of learning and memory, and he advanced a strong proposition for psycholinguists to ponder: "We cannot understand a sentence until we are able to assign a constituent structure to it" (p. 751). The problem then, given that a person hears an utterance and accepts it as a structurally well-formed utterance in his language, is to determine how he analyzes the utterance and how he provides an interpretation for this analysis that leads to comprehension.

Most recent studies of comprehension (and a few related studies on the coding and storage of syntactic structures in memory) have been conducted with adult subjects and have focused their efforts on exploring a derivational theory of complexity (DTC) proposed by Miller (1962). Miller suggested that both understanding and remembering an utterance required that the utterance be recoded in some fashion. In 1956 in reviewing research on a person's span of absolute judgment and immediate memory, Miller had noted that memory imposes severe limitations on the amount of information that one can absorb and process. But by recoding information into more manageable chunks, a person is able to overcome this basic limitation. Miller points out that, "In particular, the kind of linguistic recoding that people do seems to me to be the very lifeblood of the thought processes" (p. 95).

Assuming, then, that remembering a sentence of a language does not consist of remembering the precise sequence of sounds or words of a given utterance, Miller (1962) proposed a "schema-plus-correction" model based on direct analogy with Chomsky's early formulations of a generative transformational grammar (1957). Chomsky suggested that underlying every surface configuration of a sentence there is an underlying "kernel" form (or set of "kernel" forms) which conveys the fundamental sense or meaning of the utterance. Kernel forms and surface configurations are related by a set of transformational rules. Originally stated, Miller's hypothesis said that what is remembered of any utterance is the underlying kernel form of that utterance plus a set of footnotes indicating what operations (transformations) to apply to the kernel form to generate the original utterance. To give a very simple example, an utterance like, "The ball was hit by the boy," would be stored in memory as the kernel form, "The boy hit the ball," plus a footnote "P" indicating that if the person were asked to repeat the sentence, he should apply a passive transformation to the kernel form.

This type of thinking led quite naturally to the suggestion of a theory of complexity -- that the complexity of a sentence is directly proportional to the number of operations (transformations) necessary to generate the sentence from its underlying kernel form, or, in the case of understanding a sentence, to reduce an utterance to its underlying kernel form.

Such a derivational theory of complexity tended to impute to Chomsky's notion of a grammatical transformation the psychological reality of a mental operation. It seemed to many researchers that even if the suggested analogy between grammatical transformations and mental operations were not perfect, such a relationship would be worth testing for whatever heuristic value it might have.

Such speculation about the processes of understanding, of coding and storage for memory, and of the derivational theory of complexity led to a number of studies beyond those discussed briefly in Miller (1962) (e.g. Mehler, 1963, Marshall, 1964, Clifton, Kurcz and Jenkins, 1965, Gough, 1965, Savin and Perchonock, 1965, and Slobin, 1966). Within the limits of the types of structures studied, but over a variety of experimental techniques, predictions of the derivational theory of complexity are supported by the experimental results. In other words, the complexity of sentences of the types studied, in terms of some measure of mental activity used in understanding or remembering them, is directly predictable from a knowledge of the number of transformations needed to generate them. While such results do not prove that transformations as set forth in a grammar are direct representations of operations in the head, they do argue for the psychological reality of some set of processes directly analogous to grammatical rules of the generative-transformational type.

Unfortunately, there are both practical and theoretical limitations to these studies and to this type of approach to language performance. These limitations are discussed at length in Fodor and Garrett (1966), and we shall not discuss them in detail here. However, a few observations are pertinent to our general concern about studies of children's language development. First, as Fodor and Garrett (1966, 1967) suggest, these studies avoid the question of how sentences are interpreted. While they do show that there is differential difficulty among certain sentence types and that the relative level of difficulty is predictable from the grammatical derivation of the sentence, they do not tell us how it is that a person knows what particular strategies to apply to a sentence to interpret it. Fodor and Garrett suggest that the surface structure of an utterance contains "markers" (both of a lexical and structural nature) that provide for an individual "clues" to possible interpretations (candidate deep structure analyses) and provide a means for deciding upon a particular interpretation from among those that are possible. The complexity, then, of a given utterance of other than the most simple types may be largely a function of the extent to which surface structure clues are available to aid the interpretation process.

Another problem with the DTC studies that significantly limits their credibility, not in terms of the results obtained but in terms of the extent to which the results can be generalized, is that all of the studies investigated only an extremely limited range of construction types. In fact, the transformations used exclusively in all but one of the studies were those described by Chomsky (1957) as optional singularies: the passive, the negative, the question, and combinations of these three (Savin and Perchonock, 1965, added the emphatic and WH transformations). Why, one is caused to wonder, should the development of a theory of language complexity be approached by studying structural forms that are, by anyone's intuitions, extremely simple? Slobin (1966), in the only study of this type involving young children, found that 6 year old children understand well all of these forms and that large differences in performance over age are not discernible.

However, if one wishes to extend studies of DTC to more complex utterances, it is not at all clear how to proceed. Whereas in 1957 the status of transformational rules in the grammar seemed reasonably well established, current thinking (e.g. Chomsky, in press) suggests that decisions about whether certain types of structures are to be handled by transformational rules or by phrase structure rules are both crucial and very much at issue. For example, certain versions of the grammar (e.g. Rosenbaum, 1967) would have adjectives inserted into strings by the operation of three transformational rules. According to DTC the insertion of a single adjective into the sentence, "The boy was good," to form the sentence, "The nice boy was good," would increase the complexity of the latter sentence by a factor of three.

Such a prediction is clearly counter-intuitive and was shown to have no empirical support by Fodor and Garrett (1967). If DTC were to accept such a grammatical description of adjective, which may or may not be the best one, it would be forced to differentiate somehow between grammatical operations in general and those particular grammatical operations that count for complexity -- a distinction not easy to make on any *a priori* grounds.

Largely for these reasons, a portion of the present study owes its motivation to the work of Fodor and Garrett (1967) and Fodor, Garrett and Bever (1967). A more complete description of their studies, along with specific details of how the present study is relevant, will be presented in Chapter II. Suffice it to say at this point that their approach to the problem of how sentences are understood seems to offer more promise than the approach taken in studies of DTC.

There have been a few studies of children's comprehension of sentences that deserve some consideration. In the study by Slobin (1966), referred to above, children aged 5, 7, 9 and 11 were asked to verify, by responding true or false, whether a given sentence described a picture. While Slobin's results were similar to those obtained in other DTC studies, a couple of his findings are both slightly different and interesting. His pictures included some actions that are "reversible," that is, either party depicted could logically serve as the actor or the recipient of the action (e.g. a cat chasing a dog), and some actions that are "nonreversible," that is, where the recipient of the action could not logically serve as the actor (e.g. a girl watering flowers). With the nonreversible situations, he found no difference between active and passive sentences either in the positive or negative cases. This suggests that when it is clear from semantic constraints in the sentence who the actor must be, reversing the order of subject and object by passivizing has no appreciable effect upon understanding. Such semantic effects cannot be accounted for by DTC and are more in line with the suggestions put forward by Fodor and Garrett. Furthermore, DTC is not able to account for the difference Slobin found between negatives (more difficult) and passives (less difficult). In the end Slobin suggests that one must consider semantic and pragmatic factors, as well as syntactic ones, in accounting for performance.

The particular task Slobin used, asking a child to make a binary decision (true-false) about the relationship of a sentence to a picture, is very similar to the comprehension task employed in the Imitation, Comprehension, Production studies of Fraser, Bellugi and Brown (1963) described above. In the latter case children were asked to make a binary decision between two contrasting pictures, one of which depicted the action described by a sentence. Such binary choice situations may have the advantage of giving unambiguous experimental results, but they provide only a very limited amount of information about precisely what the child understands by a given utterance and how he understands it. Furthermore, such simple choice situations are almost impossible to design for relatively complex utterances involving more than very simple distinctions.

Probably the most interesting, but at the same time the most difficult to interpret, studies of children's comprehension have been carried out in what closely approximate normal communication contexts. Generally, the experimenter, while interacting with the child, will introduce into the communication context certain types of utterances in which he is interested and systematically note the child's responses. Some examples of research of this type can be found in the Russian literature. For example, Luria (1959a) investigated the extent to which verbal commands influence the behavior of children from age 1 1/2 to 6. He found that up to age 3 or 4 the relation between verbal commands and children's actions was very unspecific. At 3 to 4 years, with children of kindergarten background, speech appeared to have a systematic impulse value, but significant distinctions made in speech were often not observed in the child's behavior (e.g. the commands "press" and "don't press" led to identical behavior). Only at ages 5 to 6 did he find that the child's behavior became totally regulated by language.

Smith (1966) also studied 2 year old children's response to various types of verbal commands. She compared normal commands with telegraphic commands and both of those with commands in which nonsense words were inserted (e.g. Throw me the ball, Throw ball, and Ront fuma ball). Behaviors of various types were noted, but on all types the normal commands produced a significantly greater number of appropriate responses than the telegraphic commands, and the telegraphic commands were better than the nonsense. Contrary to the results of Luria, Smith's findings suggest that children as young as 2 years respond to many of the distinctions expressed through language.

Various traditional tests of intelligence and of verbal development (most recently the Illinois Test of Psycholinguistic Abilities) include components that attempt to measure children's comprehension ability. Though the tests seem adequate as means of rating children's gross abilities and comparing children on the basis of these ratings, they do not supply very specific information about children's language and how it develops. Furthermore, they are clearly tests, and it is doubtful that even an experienced psychologist can make them seem otherwise to children. At best the results of such tests should be treated as only very rough indicators of very general abilities.

The study of comprehension to be described here is in part an attempt to devise a research technique that will permit the study of a variety of utterance types within a framework that is open enough to allow a wide range of responses, yet not so open that responses are impossible to interpret. Subsequent creative use of techniques of this type may help to provide a more complete picture of language growth than is presently available.

Studies of Language and Thought

No discussion of studies of language development would be complete without some attention to closely related studies of the development of cognitive processes in children. At all stages of development language and thought are constantly interacting, and it is impossible to separate the study of one from the study of the other. In fact, that we talk about them as if they were essentially different may be as much an artifact of our limited understanding as a reflection of real difference.

Probably the most intriguing suggestion about the relationship between thought and language is that advanced by Vygotsky (1962). He proposed that as a child develops, his functioning speech system becomes largely internalized as inner speech, a highly compressed form of external speech: "Inner speech is to a large extent thinking in pure meanings. It is a dynamic, shifting, unstable thing, fluttering between word and thought, the two more or less stable, more or less firmly delineated components of verbal thought."(p. 149).[1] formulation attempts to account for the fact observed by both Vygotsky and Piaget (1955) that young children outwardly verbalize their thinking, while older children and adults internalize much of theirs, except when communicating with other speakers.

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[1] It is interesting how closely Vygotsky's description of inner speech seems to come to Chomsky's concept of deep structure (1965). It is conceivable that deep structure of language not only is the basis for the elaboration of meaning into surface structure forms but also is itself a level on which mature people "think" in terms of fundamental meaning relationships.

There is certainly considerable evidence to suggest that a very large portion of human thought (and perception, for that matter) is filtered through the language system. For example, Glanzer and Clark (1963a, 1963b) suggest that it is not reasonable to talk about the complexity of a stimulus *per se*. Complexity must be thought of as characteristic of an individual's response to a stimulus and seems to be best reflected by his ability to organize the stimulus verbally. The experimental results that Glanzer and Clark obtain to support this position are based upon a major assumption that their subjects' outward verbalizations are an accurate reflection of covert verbalizations.

Luria (1959b) in reviewing Russian studies of language and thought takes a position very similar to that of Vygotsky. After citing many studies of the ways in which spoken language modifies and influences the cognitive development of the child, he notes:

> Indeed, the evolved nondirected speech of the child is gradually condensed, becomes fragmentary, begins to appear only occasionally, is sometimes replaced by whispers, and is gradually transformed into that contracted, congealed, internal speech which participates in all mental acts. (pp. 565-6)

Much of the work of Piaget is extremely important for thorough consideration of the development of thought and language. His first general study of the subject (1955) explored the functions of speech in young children and some of its particular forms. The major purpose of this study was to propose a theory of egocentric speech (speech largely devoted to fulfilling the needs of the individual himself) and to suggest that the beginnings of logical thinking in the child could be associated with a decrease in egocentric speech behavior and an increase in speech that related the child as an individual to other children. Simply stated, the growth of reasoning ability in the child seemed closely associated with the development of an ability to engage in a true dialogue.

In a subsequent study of children's thinking (1964), Piaget explored in depth the developing ability of the child to express certain types of logical relationships. He found that while a French speaking child is capable of using the word parce que (because) from the age of 3 or 4, up to the age of 7 or 8 he uses it infrequently and equivocally to express a wide range of undifferentiated relationships such as cause, time, or sequence. More generally, the child often seems to feel relationships but does not seem able to differentiate them in verbal terms and therefore expresses them through a strategy Piaget calls juxtaposition. Juxtaposition consists of placing one sentence next to another with no signal of any relationship or simply conjoining two sentences with "and." However, between the ages of eight and twelve, as the child increasingly participates in true dialogues, he begins to make relationships explicit.

Using a technique that required children to complete sentences, Piaget studied intensively the types of relationships children express by certain logical connectives (because, therefore, but, although) as their ability to make relationships explicit matures. He found, for example, that as "because" becomes differentiated from "and," it is first used to signal relations of physical causality, then to signal relations of motivation or psychological causality, and finally to signal relations of logical justification. By age 12 then, the child has learned to express at least three distinct types of complex relationships with a single syntactic structure. Similarly, Piaget found that although the conjunction "but" is used loosely by young children, it is not differentiated as a term for expressing logical discordance until the child is close to 12. At this point "although" also comes into use indicating, Piaget suggests, that the child's understanding of causality has developed to the point that he can now express the idea of exception to causal relations.

Piaget's intensive study of children's use of logical connectors that signal causal relationships prompted the inclusion in the present study of a range of logical connectors that signal conditionality or contingency. However, where Piaget elicited productions from children by asking them to finish incomplete sentences, the present study requires children to indicate comprehension of various utterance types.

The rationale for the procedure used will be presented in Chapter II.

Intensive studies of the developing relation between language and thought in children pose many questions that require further study. While it has been argued that language directs thought and is therefore essential for understanding, a few recent studies suggest that although explicit verbalization of some concept or relation can often help to prepare an individual for understanding it, understanding often emerges prior to an ability to express the concept or relation explicitly (e.g. Mehler and Bever, 1967, Sinclair, 1967). Our educational practice, with regard to children's verbal and cognitive development, assumes that a child really understands some concept only when he can express it verbally in a clear, coherent, logical, and grammatically correct manner. Thus, curriculums are geared toward developing verbal facility and sophistication, and measurement of a child's development is conducted in almost totally verbal terms. Similarly, the problem of poorly educated youth in our nation's ghettoes has been increasingly viewed as a problem of language deprivation, and remedial programs have been suggested that focus heavily on language improvement as a critical means for fostering cognitive growth. To what extent such a strong emphasis upon language *per se* is justified deserves careful consideration. It is possible that our assumption of the primacy of language in the overall development of the child has led us to an over-simplified view of an obviously complex process. A more comprehensive and insightful understanding of how children learn and grow and of the role language plays in development would certainly serve to enrich both our schools and our children.

CHAPTER II

EXPERIMENTAL DESIGN

General Approach

Of the many changes that take place as a child grows up, there are three that contribute decisively to his growth as an intelligent human being. His world is constantly expanding, rather dramatically at birth, more slowly during infancy, and again dramatically when he goes to school. Each step of the way there are not only novel things, events, and feelings, but there is also an expanding set of relations or contingencies among them. Concurrently, the child's ability to relate himself to the world is quickly developing. He segments and organizes the world by applying to it an increasingly sophisticated set of strategies, the most powerful of which is that made possible by his language. Finally, as his world expands and his ability to understand it deepens, he engages increasingly with other human beings, people whose primary means of interaction is verbal.

When a child enters school at about age 5 or 6, the most significant change he must cope with is the tremendously expanded range of other human beings, children and adults, he is asked to relate to. While language is one of the best devices he has for handling the situation, he is not accustomed to using language as a primary means of interaction and has only begun to explore the wide range of communication patterns his language makes available Before school, within the framework of shared understandings, experiences, and feelings that characterized his life with his family and close friends, intentions, ideas, and feelings could often be conveyed succinctly and elegantly in very brief, unelaborated verbal expressions. Understanding among individuals could largely be assumed. In a world of strangers such an assumption is no longer valid, and the child entering school is faced with the task of learning how to verbally elaborate his intentions to make his meaning considerably more explicit.[1]

This study was conducted to explore the ability of children from 6 to 12 to understand certain relatively complex relationships as they are commonly signaled syntactically in our language. Underlying the study is the hypothesis that development in language performance during this age range is, in some measure, a function of a growing ability to comprehend the precise meaning of a variety of structural signals and to produce them in appropriate situations. The young, verbally immature child can, of course, signal certain types of relations through his language: subject-verb-complement relations, adverbial relations of place, time, manner, etc., adjectival relations that attribute qualities, etc.

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[1] This analysis is partially based upon Bernstein's theory of elaborated and restricted codes. See Bernstein (e.g. 1961, 1967).

Characteristically, however, his ability is confined within the limits of simple active declarative sentences. When he wishes to express more complicated relations, relations that tend to stretch the bounds of a simple sentence, he typically conjoins or juxtaposes related thoughts, expressed in simple sentences, without specifically signaling whatever relationship he intends. For example, if a child says, "I like ice cream. I want cake for dinner," it may not be entirely clear what his intention is. But if he says, "I like ice cream, but I want cake for dinner," his mother can be reasonably sure that he wants only cake and not both cake and ice cream.

However, such examples are trivial, and, when taken out of the context that naturally surrounds them, can be misleading. Rarely in normal discourse does the meaning of what one is attempting to convey hinge upon any one signal. Communication is accomplished through language partly because it is a system that can mulitply redundancies. Or, to put it another way, language is a system that does not attempt to convey too much information at once and frequently reinforces whatever information it is conveying. For instance, if one says, "It is raining out. I am going to wear my coat," the contingency relationship between the two statements is quite clear. To signal the relationship in some way, such as, "Because it is raining out, I am going to wear my coat," is not entirely necessary, but such redundant signaling may facilitate understanding.[2] Therefore, even though it can be maintained that in normal discourse explicit signaling of relationships is often not totally necessary, it tends to increase the likelihood that communication of one's intent will be accomplished and understanding will be achieved.

On the other hand, because language is a system that also has the potential for multiplying ambiguities, explicit verbal signals are often the only means of resolving what would otherwise be ambiguous statements. And in special forms of verbal communication, particularly writing, care must be taken to provide such explicit signals because other signaling devices such as intonation and gesture are lost and because there is no opportunity to modify one's verbalizations in the light of immediate feedback from a listener.

One of the most frequent complaints teachers make about children is that children don't understand instructions. All too often, the problem is that the child just doesn't hear or isn't paying sufficient attention to hear the instruction clearly. Furthermore, more often than teachers are usually willing to admit, their instructions are unclear and confusing. Nonetheless, there is probably some legitimate basis for the teacher's complaint, for young school age children, while clearly in command of the language system, have only just begun to develop an understanding of the vast range of expressive tasks to which the system can be applied and the specific devices (both linguistic rules and social conventions) that are used by mature speakers to aid communication.

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[2] Rui (1966) makes this point in her analysis of children's comprehension of conjunctions.

To what extent, then, have children between the ages of 6 and 12 developed in their ability to understand some of the ways in which mature speakers explicitly signal relationships? The study described here is an attempt to begin to answer this question by closely exploring a very small number of utterance types. As noted in Chapter I, such a study can be only a snapshot of a very broad and complex range of phenomena. In limiting our study to evidence of the child's ability to comprehend utterances, we are assuming that comprehension, as defined by the experimental situation, is sufficient grounds for ascribing "knowledge" to the child. Although it is not always possible to give evidence that a child who understands a particular utterance is also capable of producing that same utterance to express the same idea in an appropriate situation, we can be relatively certain that comprehension at least indicates that the child has reached a point in his development that is prior to and necessary for production.

Since comprehension must be measured in terms of some response on the part of the subject, certain assumptions must be made if valid inferences about comprehension are to be made on the basis of these responses. It must be assumed that the child both pays attention to the utterance and hears it correctly. It must also be assumed that a child's response is a direct reflection of his understanding of the utterance and cannot be attributed either to a reluctance to respond or to understanding or misunderstanding caused by factors extraneous to the utterance itself. While we must make these assumptions in this study, special effort has been devoted to designing an experimental situation that makes them less questionable than has often been true of studies of comprehension in the past.

Structures Studied

The utterances included in this study can be divided into four distinct types on the basis of the syntactic devices employed to signal the intended relationships. The first type is composed of simple-active-declarative utterances. The second type is composed of utterances that employ specific logical connectors to signal complex logical relations. The third type is composed of utterances that employ distinct verbs to signal distinct complement relations, but where the relation is complicated by the absence of a helpful,but structurally redundant, signal of pronominal identification. And the fourth type is composed of utterances that employ relative pronouns to signal the complex subject-verb-object relations of self-embedded sentences. We shall discuss each of these types in detail.

Type I - Simple Statements. Several simple-active-declarative utterances were included in the study in order to compare other forms to them. The three following types were included (Examples are taken from the actual instructions used in the game that served as a testing instrument. See the description of the game below and the complete set of instructions in Appendix A.):

I-A1: Simple statement - one space.
Ex: "You may move a circle one space."

I-A2: Simple statement - two spaces.
Ex: "You may move a square two spaces."

I-A3: Simple statement with choice - one space.
Ex: "You may move either a circle or a diamond one space."

I-A4: Simple statement with choice - any space.
Ex: "You may move any piece to any space on the board."

Type II - Logical Connectors. The English language possesses an extremely wide range of logical connectors that permit the individual to express relations both within sentences and between sentences. Studies of the productions of children have shown that low frequency use of such connectors (coordinate and subordinate conjunctions, some adverbs, and various sentence connectors - but excluding "and") is an indicator of verbal immaturity (e.g. Labrant, 1933, Watts, 1944, Harrell, 1957, Loban, 1963 and 1966, Cazden, 1966-1967 and Weathersby, 1967). Piaget (1964) and Rui (1966) both used sentence completion paradigms to elicit responses to certain forms from children, and Watts (1944) devised a pencil and paper test of comprehension for a large number of forms that is used by Loban (1963 and 1966) to supplement his production data. With the exception of the work by Piaget that we described in some detail in the first chapter, none of these studies looks carefully at how understanding of a particular form develops or at how understanding of various forms compares across forms.

The choice of particular forms to be used in this research was determined in part by the nature of the test (see below) and in part by the author's prior experience in using the test as an instructional game with 7 to 9 year olds (mostly lower class) in two summer programs in the city of Boston. In general, the author observed that utterances expressing contingency relationships (various forms of the conditional, in particular) posed problems of interpretation for the children. Therefore, it was decided to look most thoroughly and intensively at utterances expressing conditionality, to compare them with utterances expressing temporal and limiting contingencies, and to contrast both with simple-active-declarative statements, as well as with the other two form types included in the study and described below.

The English language has many ways of expressing conditionality. Using "if" as a signal to introduce a subordinate clause is undoubtedly the most common form, but numerous other forms are possible. For example, Curme (1947) gives the following:

I will come provided that I have time.
I do not care so long as you are happy.
I will be there in case you want me.

He is fierce once he is angered.

He also notes many abridged forms and forms where the "if" clause is replaced by other constructions. For example, all of the following convey conditionality:

Raised in a better home, he would have succeeded.
Strictly speaking, that is not true.
To judge by his appearance, he is a gentleman.
Conditions being favorable, he might live.
Without him, I would be helpless.
Any boy who did that would be laughed at.

Recent grammatical formulations have not attempted to treat such expressions of conditionality, largely because the relationship expressed derives from two separate sentences, a question and a response, joined together because of their conceptual relation, the relationship then being signaled by some special form (e.g., "if").[3] Clearly, the sense of the conditional is that it asks a question, the answer to which conditions the following statement. For example, the conditional, "If it is nice tomorrow, I will go," asks a question, "Is it going to be nice tomorrow?" The answer to this question determines whether or not the action expressed in the main clause will be undertaken. The same type of relationship exists between the following two sentences, although it is not explicitly signaled: "Is the movie good? I will go see it."

It is interesting to note that certain forms for expressing conditionality preserve the syntactic form of a question-statement. That these forms generally are in the subjunctive mood and therefore sound slightly archaic or poetic suggests the possibility that they are older forms in the language, perhaps even forerunners of "if" forms.[4] For example, the subordinate clause in each of the following conditional sentences has the word order of a standard English question (i.e. auxiliary verb - noun - verb - complement or be - noun - complement):

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[3] I am indebted to Professor Wayne O'Neil for this suggestion.

> Should he go home, he will get dinner.
> Had he known it, he would have come.
> Be he a man, he will fight.
> Were he honest, he would pay.

Piaget (1964) suggests, as noted in Chapter I, that the growth of logical thinking in the child can be traced to the time when language begins to serve less of a strictly egocentric function and when the child begins to use language as a means of communicating with others. Logical thinking, he suggests, grows out of a dialogue. Vygotsky (1962) would add that as dialogue develops, it also becomes internalized. We have tried to show above that the conditional may be seen as a brief dialogue form, a special way of coding a close relationship between two thoughts that "communicate" with each other. Therefore, it might be argued that the growth of conditional thought in the child depends upon the internalization of dialogue forms that express conditionality.

Also, as noted in Chapter I, Loban (1963, 1966) claimed that those children who most frequently used language to express tentativeness were the ones who also had the greatest control over language as measured by other indices. Since expressions of conditionality are one of the major resources the language has for expressing tentativeness, the child's ability to understand and use such expressions may be a major factor in his linguistic and cognitive growth.

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[4] Watts (1944) suggests that many connectives appeared rather late in the history of the language (e.g. "although" appeared first in 1325 according to the Oxford English Dictionary) and that their appearance in children's speech roughly follows the order in which they came into the language. "If," according to the OED, may have entered the language through the Old Norse subjective which signified doubt or hesitation.

To investigate how well children between the ages of 6 and 12 understand various types of conditionals, we included the following types in the study:

II-D1: Conditional with "if" initial - one referent.
Ex: "If you have a circle, you may move it one space."

II-D2: Conditional with "if" initial - two referents.
Ex: "If you have a diamond, you may move a triangle one space."

II-D3: Conditional with "if" final - two referents.
Ex: "You may move a square one space if you have a circle."

II-D4: Conditional, subjunctive with "should" initial - one referent.
Ex: "Should you have a circle, you may move it one space."

II-D5: Conditional, question form - one referent.
Ex: "Do you have a large piece? Then you may move it one space."

It has often been noted that children, as well as adults, have greater difficulty in interpreting verbal expressions involving negatives than in interpreting corresponding affirmative expressions (e.g. the studies of Wason, 1959, 1961, and Slobin, 1966). For this reason two kinds of negative conditional utterances were included in the game to compare with the affirmative cases and with each other. The first kind involved inserting a "not" in the subordinate clause to give the following:

II-E1: Conditional with "if + not" initial - two referents.
Ex: "If you do not have a large piece, you may move a circle one space."

II-E2: Conditional with "if + not" final - two referents.
Ex: "You may move a square one space if you do not have a circle."

Functionally equivalent to utterances with "if + not" are utterances where "if + not" is replaced by "unless." If interpreted correctly, the following utterances would elicit the same responses as the utterances of Type II-E above:

II-F1: Conditional with "unless" initial - two referents.
Ex: "Unless you have a large piece, you may move any piece two spaces."

II-F2: Conditional with "unless" final - two referents.
Ex: "You may move a circle two spaces unless you have a large piece."

Summarizing, four forms of the affirmative conditional were employed ("if" [one referent], "if" [two referents], should, and question). Two forms of the negative conditional were used ("if + not" and "unless"). And, where appropriate, the subordinate clause was placed in both initial and final positions.

Utterances expressing temporal contingencies are very closely related to conditionals in conceptual terms. The two sentences, "I will meet him if he comes," and "I will meet him when he comes," both express the fact that the act of meeting someone is contingent upon an action of that person. However, there does seem to be a substantial grammatical difference. As noted above, the conditional may best be thought of as the result of combining two sentences, a question and a statement. Temporal contingency, on the other hand, is expressed within a single sentence by a sentence adverbial. For example, the sentence, "I will meet him when he comes," has the same deep structural pattern as the following sentences:

> I will meet him later.
> I will meet him tomorrow.
> I will meet him the day after tomorrow at two o'clock.

Because expressions of temporal contingency employ only a normal single sentence structure, it might be argued that they would be easier to interpret than conditionals which link two distinct structures together. Therefore, for comparison with the conditionals given above, four types of utterances expressing temporal contingency were included in the study:

II-C1: Temporal contingency with "before."
Ex: "Before you move a diamond one space, you must move a circle one space."

II-C2: Temporal contingency with "after."
Ex: "After you move a triangle one space, you may move a square one space."

II-C3: Temporal contingency with "when."
Ex: "When you have moved a triangle one space, you may move a circle one space."

II-C4: Temporal contingency with "as soon as."
Ex: "As soon as you have moved a circle one space, you may move a triangle one space."

It can be objected that there is some ambiguity in these instructions. For example, the instruction, "After you move a triangle one space, you may move a square one space," can be interpreted to mean, "First move a triangle one space and then move a square one space," or it can be interpreted to mean, "When the opportunity is presented to you to move a triangle one space, then and only then can you also move a square one space." In developing the game, the author found that children did not sense this ambiguity and interpreted all instructions of this form as meaning that they could make both moves if they made them in proper sequence. It is worth noting, however, that since these instructions do require the children to make two moves, they differ from the conditionals which only require one move.

Another type of contingency that can be imposed upon action is limitation, often signaled by conjunctions of logical discordance (frequently called adversatives). Two distinct forms of expressions of limiting contingencies were included in the study in order to compare them with the conditionals and temporal contingencies.

II-B1: Limiting contingency with "although" initial.
Ex: "Although you may not capture a piece on this move, you may move a triangle to any space on the board."

II-B2: Limiting contingency with "although" final.
Ex: "You may move a square to any space on the board although you may not capture a piece on this move."

II-B3: Limiting contingency with "but."
Ex: "You may move a triangle two spaces, but you may not capture a piece on this move."

Type III - Ask-Tell. The difficulty that utterances of Type III create for children was suggested to the author by Carol Chomsky, who is presently conducting a thorough exploration of the problem and who will hopefully explain fully its syntactic aspects (1968). It is a reasonably well established fact that when asked to interpret passive sentences where the nouns are semantically interchangeable (often called non-restrictive passives), young children will interpret them as active sentences (Fraser, Bellugi, and Brown, 1963 and Slobin, 1966). For example, it is not unlikely for a young child to interpret the sentence, "The boy was hit by the girl," to mean that the boy hit the girl. Perhaps in the absence of clear semantic signals, the child misses the available syntactic signals and applies a very general strategy (one that works a large percent of the time) that says to interpret the first noun as the actor and the second noun as the person or thing acted upon. On the basis of this evidence it might be suspected that if the child confuses actor and recipient in non-restrictive passives, he might have difficulty in other situations that call for understanding the same distinction. The child might, for instance, have some difficulty in understanding the actor-recipient relationship in sentences like:

John is easy to please.
John is eager to please.

Carol Chomsky (personal communication) has suggested that the verbs "ask" and "tell" in certain contexts raise this same problem. Given the two sentences, "Joe asked Mary which toy to buy," and "Joe told Mary which toy to buy," children have some difficulty (more so with the former) interpreting correctly who is performing the action of buying the toy. There is a tendency to interpret both sentences by saying that Mary will buy the toy. Although the verb "tell" seems totally unambiguous in meaning, the verb "ask" is at least partly ambiguous, for it is often used to convey the sense of tell (e.g. "The teacher asked Bill to leave the room." Here Bill will do the leaving. But note, "Bill asked the teacher to leave the room," where Bill will still probably do the leaving.) In the sentences given above, where a WH-form follows the verb and there is no further pronominal identification, the difficulty in giving the proper interpretation to "ask" is compounded. In theory at least, providing an additional syntactic signal in the form of an identifying pronoun should make interpretation easier (e.g. "Joe asked Mary which toy he should buy.").

Sentences using "ask" and "tell," with and without the pronoun, were included in the present study to see if they indeed posed difficulties for children on the specific task used here and to see if the presence of the pronoun, an additional syntactic signal, would facilitate understanding.

III-G1: "Tell" without pronoun.
Ex: "Tell your opponent which piece to move one space."

III-G2: "Tell" with pronoun.
Ex: "Tell your opponent which piece he should move one space."

III-H1: "Ask" without pronoun.
Ex: "Ask your opponent which piece to move one space."

III-H2: "Ask" with pronoun.
Ex: "Ask your opponent which piece you should move one space."

Type IV - Embeddings. The inclusion in this research of a fourth general type of construction was motivated by recent experiments on factors determining sentential complexity (Fodor and Garrett, 1967 and Fodor, Garrett, and Bever, 1967; see also the discussion in Chapter I). Whereas utterances of Type II were included to investigate children's ability to understand various relations signaled by certain logical connectors, utterances of Type IV were included both to see how well children understand sentences with embedded elements (compared with other types of sentences) and to see if the presence of a specific syntactic signal aids understanding. Fodor and Garrett have shown that if in very complex embedded sentences (e.g. two levels of self-embedding) optional structural signals (in this case relative pronouns) are deleted, interpretation of the sentence by adults is made more difficult. For example, relative pronouns can be deleted from the sentence, "The boy that the dog that the cat chased bit ran down the street," to give the sentence, "The boy the dog the cat chased bit ran down the street." As they point out, the problem in understanding a self-embedded sentence is in finding the proper subject-verb-object relations. Taking the example given above, to interpret the sentence one must find the following relations that are expressed structurally in the sentence: the cat chased the dog, the dog bit the boy, and the boy ran down the street. Fodor and Garrett found that if the relative pronoun is present, the task of recovering these relationships, that is interpreting the sentence, is facilitated.

Sentences involving two levels of self-embedding, like the example given above, are assumed to be significantly beyond the comprehension of children; in fact, their acceptability for adults is highly questionable. Therefore, for this study we chose sentences having only a single level of self-embedding, with and without the relative pronoun, to explore children's ability to provide interpretations for such structures.

IV-I1: Embedding without relative.
Ex: "The piece your opponent just moved may be moved two spaces backwards."

IV-I2: Embedding with relative.
Ex: "The piece that your opponent just move may be moved two spaces backwards."

Embedded sentences do bear some conceptual resemblance to the utterances described above as Type II. The embedded portion of the sentence acts as a limiting contingency upon the rest of the sentence and is thus related to Type II-B.

For example the same meaning that is conveyed by the above embedded forms may be conveyed as follows: "You may move a piece two spaces backwards, but it can only be the piece that was just moved by your opponent."

Subjects

Twenty boys were tested at each of three age levels, 7, 9, and 11 years. The subjects were all students in the Franklin Elementary School, Lexington, Massachusetts, an upper-middle class suburban community northwest of Boston. A deliberate attempt was made to restrict subjects tested to those of average intelligence (I.Q. range of 100-120) so that the results would not reflect wide extremes in ability. Because I.Q. scores were not available for some of the youngest children at the time of testing, the teacher's judgment was accepted instead. Consequently, a few children in the youngest group had I.Q.'s in excess of the desired range. Table I summarizes ages and I.Q.'s for the three groups.

Table 1

Ages and I.Q.'s of Subjects at Three Age Levels

	Level I	Level II	Level III
Mean Age:	7:7	9:8	11:4
Age Range:	7:1-8:0	8:9-10:2	10:3-12:0
Mean I.Q.:	116.6	113.2	113.4
I. Q. Range:	103-150	92-126	106-121

Testing Instrument

In the course of two summer programs working with first through third graders, the author explored the use of various language games in the classroom (e.g. Linguistic Block Series, 1963; Attribute Games and Problems, 1965; and Gotkin, Language Lotto and Matrix Games, 1966, 1967). While each of these games has some value in helping to develop language skill, they all suffer to some degree from being artificial as games and too general in their applicability. If a game is to be a successful motivating device, it must be truly a game and not an exercise disguised as a game, a distinction that children readily make. Furthermore, if it is to instruct, it should do so in areas where instruction is needed, not where concepts or skills are already well learned.

While the author was studying various existing games and their instructional value for children, he developed a new game that improved upon them and also provided a format for investigating aspects of children's language abilities. During two summer school programs numerous versions of this game were made available for children to play. Since the game proved to be very popular, the author had ample opportunity to observe children playing it, as well as to modify it both on the basis of children's behavior and on the basis of their suggestions for improvements. This experience in using the game as an instructional device led the author to believe that it could also be used in a more rigorous way as a means of systematically exploring children's comprehension of various structural patterns in language.

The game is very closely related to checkers, a game that most children have encountered or know how to play by the time they go to school. It is played on a checker board, moves are made as in checkers, and the goal of the game is to capture the opponent's pieces. However, the pieces used in this game are different. Each player has eight small wood pieces contrasting in color with those of his opponent. Two of these pieces are triangles, two are squares, two are diamonds, and two are circles (the actual pieces used are taken from Attribute Games and Problems, 1965). The different shapes are used to provide some range of reference (though a highly limited one) for the instructions. Each move in the game is thus uniquely determined by an instruction that pertains to no more than two pieces of a specific shape. As in checkers, there are also "kings," that can move forward and backward, but in this case they are larger pieces of the same shape obtained when a small piece is moved into the opponent's back row.

The major difference between this game and checkers is that each move is determined by an instruction that the child must interpret in order to make the move. When the game was being developed, instructions were typed on cards, and children read the cards and moved accordingly. Though this method of presenting the instructions was found to have some side benefits in helping poor readers, for the purposes of this research, it was felt that oral instructions would be preferable for two reasons: many of the younger children might have reading problems that would complicate interpretation of the results, and having cards to refer to simplifies the task because the child can always check himself against the card.

While instructions might have been recorded on an ordinary recording tape, using an elaborate stop-start mechanism devised so that children could push a button each time they desired to hear an instruction and so that the tape would stop at the end of each instruction,a more suitable method of presentation was found. The Bell and Howell "Language Master" is a tape recorder specially designed to read from and record on cards that have been prepared with a strip of recording tape running across the bottom. The machine is used most widely for instruction in foreign languages, but it seemed ideally suited to the purposes of this study. Instructions could be individually recorded on the cards and then revised or reorganized as many times as necessary without effecting other instructions. Also, having the instructions on cards that the child himself could play on the machine increased the child's feeling of participation in the game. It was found that for many of the instructions used in the game the available Bell and Howell cards were not sufficiently long. By carefully cutting two cards and taping them together, a single card, about two thirds the length of two separate cards could be made. Ninety-six of these cards were made (forty-five for each player plus three trial cards for each player), and the instructions (see Appendix A) were recorded on the cards by the experimenter. Each card was checked carefully by the experimenter and another adult for naturalness and consistency of intonation as well as for clarity.

Because even an interesting game can become tedious for children if it is too long, it was decided to try to limit total playing time to about thirty minutes. During several pilot runs of the game with children in the Fayerweather Street School, a private elementary school in Cambridge, Massachusetts, it was found that forty-five instructions per child made the game last about half an hour and that the children's involvement in the game at the end of this period of time was not noticeably diminished. It was decided, therefore, that the game would end arbitrarily after each child had responded to forty-five instructions, and the winner would be determined on the basis of the number of pieces remaining on the board, large pieces counting twice as much as small pieces.

Having decided the length of the game, it then became necessary to design the game in such a way that it could not be won by a child before all the instructions had been used. During pilot testing, the order and nature of the instructions had to be modified many times to insure that the game would always outlast the instructions.

A more significant complication in designing such a game for research purposes stems from a need to have most instructions apply to conditions on the game board such that a child is really able to make a move on the basis of the instruction he has received. For example, if an instruction tells a child to move a triangle and he doesn't have one because both his triangles have been captured by his opponent, he cannot move. Though most children when unable to move give some clear indication that they have understood the instruction and that they realize that they cannot make a move, some react ambiguously and make it difficult to score their responses reliably. On the other hand, it was considered occasionally desirable to have a situation on the game board where the child would not have a particular type of piece so that he could react positively to such instructions as, "If you do not have a square, you may move a circle one space." Therefore, specific efforts were made to arrange instructions in such a way that a full range of possible kinds of responses would be elicited which could also be reliably scored.

The use of this game as a testing instrument has several important advantages, and a few disadvantages, in studying the development of language skills with school aged children. First, it provides a reasonably natural language situation. Chidren play games frequently, and many of the games they play involve interpreting instructions. Secondly, though the game context is natural, it is well enough constrained in terms of the range of possible responses on the part of the child so that there is high comparability both across instruction types and across children. In particular, the scope of reference within the game is highly constrained, insuring that performance is not a reflection of the child's knowledge of the world, but solely of his ability to interpret the instructions. Since the child need know only a very limited number of words in order to play, one can be reasonably sure that any difficulties in interpretation are a function of either knowledge of those particular words or of the syntactic structure of the instruction. Finally, considerable experience in playing the game with children and in watching them play it by themselves convinced the author that the game stimulates a high level of motivation. One can have considerable assurance that the children are doing their best to interpret the instructions correctly.

Using a game as an experimental device does tend to introduce some degree of "noise" into the situation that is not possible to control fully. For instance, it can be argued that the difficulties a child has in executing the instructions are more a function of his attempts to devise a strategy to beat his opponent than of his ability to understand the instruction. Though this is a valid criticism, considerable experience in using the game has shown that children seem to give little attention to devising a game strategy the first time they play it. On first encounter, their energies seem almost totally devoted to the superficial aspects of interpretation and moving pieces correctly -- so much so that they often fail to capture pieces when they are able to.

A more significant problem is that when two children play the game with each other, one child's responses will tend to influence those of the other child. While the claim that influence is operating is reasonable, given two children involved in the same activity, it is important to understand precisely what the claim of influence amounts to. Let us assume that there are two players, A and B, and that A receives an instruction. If both A and B understand the instruction and A performs correctly, B has not been influenced since he understood the instruction anyway. If both A and B do not understand the instruction and A performs incorrectly, B may assume that A did understand and therefore be negatively influenced. However, since B didn't understand himself, such influence would have to be of the form that B learns that he should do just as A did when he gets the same instruction. But given the complexities of the game and the fact that identical instructions never followed one another, this seems unlikely. If A understands the instruction and performs correctly but B does not understand, again B may be said to be in a position to learn from the move that A makes. But again, as just argued, the learning task is substantial, for B either would have to figure out precisely why what A did was a correct interpretation of the instruction or he would have to remember just what A did. Finally, if A does not understand and moves incorrectly, but B understands and realizes that A has made an error, B may correct A. In this last case influence is clearly a function of the extent to which B, in correcting A, explains to A why he moved incorrectly. In the discussion of results we shall devote some attention to this last case which seems intuitively to be the one where the claim of influence can be mostly strongly supported.

Treatment

Two children from the same age group played the game with each other. Each child received all forty-five instructions in a fixed order, but the order for player A of each pair differed from the order for player B so that instructions of the same type did not follow each other. However, the overall arrangement of instructions within each order followed the same pattern. The playing pieces were laid out on the board in a set sequence (from left to right, circles, diamonds, triangles, squares). Each pair of children received a brief explanation of the game which included the following: the names of the pieces, how the pieces move (diagonally on black squares only), how opponent's pieces are captured (by moving onto a space occupied by the opponent, not by jumping over his piece), how large pieces are obtained and their value, the meaning of the word "opponent," how it is determined who wins, and how to know how to move (from the instructions). In order to keep all moves as "honest" as possible during the course of the game, the subjects were encouraged to correct their opponent if he made an error. If a player made an error and it was discovered by his opponent, he was required to take back his incorrect move and was not allowed to move again on that turn. The experimenter agreed to arbitrate disputes and clarify rules when necessary. Finally, each player listened to three sample instructions of the simple-active-declarative type and made three practice moves. This helped to familiarize him with how to place cards in the machine and accustomed him to listening to what they said. Subjects were warned that they would only be able to hear an instruction once and if they didn't hear it or didn't understand it, they would miss their turn.

The subjects were also told that they were being asked to play the game to help the experimenter and his assistant find out how well children could play such a game. The experimenter explained that he had invented the game with the hope that it would turn out to be a game that children would like to play and that he needed an opportunity to watch children play it in order to find out how good it was. After this explanation the subjects were asked if they would mind helping the experimenter by playing the game for him.

Each game session was observed by the experimenter and his assistant. The experimenter observed the course of the game, made specific notations of correct and incorrect moves for each instruction, and answered questions that arose during the course of play. The assistant sat some distance away from the game board but where he could observe the reactions of the subjects closely. He was instructed to time the interval between the end of the instruction and the first indication on the part of the subject that he understood. Timing was done with a Heuer stopwatch readable to tenths of a second. The timing activity was sufficiently remote from the game so as not to intrude upon the children's activity. All game sessions were tape recorded with a Stenorette office dictating machine which provided recordings of sufficiently high quality and greatly facilitated transcription. Tapes were transcribed by the experimenter for whatever clues they might provide to the children's understanding of particular instructions. After each session the children were asked to express their reactions to the game.

Variables

The major independent variables in this study were the specific types of utterances used for giving instructions in the game (summarized in Table 2) and the age levels of the children playing the game. Secondary independent variables to be considered in the interpretation of the results were: the effect of being either Player A or Player B in each pair of players, the effect of the position of the subordinate clause in the instructions (initial versus final position), the effect of learning over the course of the game, and the effect of influence of one player upon the other.

The dependent variables were the number of correct responses made by subjects in interpreting instructions and the latencies of their responses. In addition, observations of the experimenter and his assistant and tape recordings of the game sessions were made for whatever information they might convey about problems, confusions, and behaviors not precisely measurable through scores and latencies.

Table 2

Summary of Types and Frequencies of Utterances

Type	Subtype	Frequency	Description
I-A	1	2	Simple, 1 sp.
	2	1	Simple, 2 sp.
	3	1	Simple, choice, 1 sp.
	4	1	Simple, choice, 2 sp.
II-B	1	2	Limit. Cont., "although" initial
	2	2	Limit. Cont., "although" final
	3	2	Limit. Cont., "but"
II-C	1	1	Temp. Cont., "before"
	2	1	Temp. Cont., "after"
	3	1	Temp. Cont., "when"
	4	1	Temp. Cont., "as soon as"
II-D	1	3	Cond., "if" initial, 1 ref.
	2	2	Cond., "if" initial, 2 ref.
	3	2	Cond., "if" final, 2 ref.
	4	2	Cond., "should" subj., 1 ref.
	5	1	Cond., question, 1 ref.
II-E	1	2	Cond., "if + not" initial, 2 ref.
	2	2	Cond., "if + not" final, 2 ref.
II-F	1	2	Cond., "unless" initial, 2 ref.
	2	2	Cond., "unless" final, 2 ref.
III-G	1	2	"tell" minus prn.
	2	1	"tell" plus prn.
III-H	1	2	"ask" minus prn.
	2	1	"ask" plus prn.
IV-I	1	3	Embed. minus rel.
	2	3	Embed. plus rel.

CHAPTER III

RESULTS AND DISCUSSION

Scoring and Preliminary Analysis

Each subject was scored correct or incorrect on his response to each instruction in the game and received a latency score for the time it took him to indicate understanding of each instruction. Thus on each instruction a subject could receive a score of 1 or 0 and a latency estimate ranging from a few tenths of a second to many seconds.

For the purposes of overall analysis the several scores for each utterance type were combined. Then a mean score for each subject on each utterance type was computed. For example, if on Type I-A, which consisted of five separate instructions, a subject made one wrong move, his mean score for that type would be 0.80. For latencies, a median for each subject on each utterance type was calculated as the best summary of the subject's performance. In this case medians seemed preferable to means because the means would have been too easily influenced by any extremely deviant individual performances.

Prior to conducting an overall analysis of the data, a preliminary analysis was made to see if there were any differences between subjects who received instructions in order A and those who received them in order B. Since the mean score for all subjects receiving order A was virtually identical to the mean score for all subjects receiving order B (A = 0.8172, B = 0.8233), and since there was no reason to believe that the two orders would produce different results, it was decided to pool the data from the two orders for all further analysis.

General Analysis - Scores

A cursory look at the data obtained in this study indicates that older children generally performed better than younger children on all utterance types and that performance on individual utterance types varied widely from one type to the next. Table 3 summarizes the data by giving the mean scores of the twenty subjects on each type at each age, as well as the overall mean scores for types and ages (a summary description of all utterance types is presented in Table 2, Chapter II).

Table 3

Mean Utterance Scores for Children on Nine Utterance Types at Three Age Levels

Age	Utterance Type									
	I	II					III		IV	
	A	B	C	D	E	F	G	H	I	Total
7	.98	.91	.78	.98	.86	.21	.73	.45	.88	.75
9	1.00	.92	.83	.97	.78	.31	.83	.62	.90	.79
11	.99	.77	.93	.98	.91	.90	.98	.77	.99	.91
Total	.99	.86	.84	.98	.85	.48	.85	.61	.92	.82

To get a broad picture of the magnitude of the effects that are discernible in Table 3 and of the factors that are making the greatest contribution to the effects, the data were analyzed by a two-way analysis of variance for a split-plot design with fixed effects (Edwards, 1964). With this design, as was done in presenting Table 3, subjects are nested within age levels, twenty subjects per age. Table 4 summarizes the data for the analysis of variance.

Table 4

Summary of Analysis of Variance of Scores

Source	SS	df	MS	F
Rows (age level)	2.46	2	1.23	24.60*
Columns (utterance type)	13.86	8	1.73	34.60*
Interaction	5.55	16	0.35	7.00*
Error (within rows)	2.83	57	0.05	
Error (within cells)	22.46	456	0.05	
Totals	47.16	539		

DF for Rows: 2, 57; for columns: 8, 456; for interaction: 16, 456
F-Ratios required at .01: for rows: 4.98; for columns: 2.51; for interaction: 2.04
*significant at or beyond the .01 level

Having thus shown that there exists a significant effect due to the type of utterance, a significant effect due to age level, and a significant interaction between these two, we can proceed to find those factors that contribute significantly to these general effects. By using a post-hoc comparison of all means recommended by Hays (1963), we can look separately at the age level and utterance type effects.

Table 5 compares the mean scores for age levels:

Table 5

Comparison of Mean Scores for Age Levels

			Age Level	
		Mean	9	11
	Mean		0.79	0.91
Age Level	7	0.75	-0.04	-0.16**
	9	0.79		-0.12*

Difference required for significance at .05 level: 0.10
Difference required for significance at .01 level: 0.13

*significant at or beyond the .05 level
** significant at or beyond the .01 level

Thus, as might well have been observed from the means reported in Table 3, we can see that the performance of children at age 11 was significantly better than the performance of children at age 7 and 9. While the performance of children at age 9 was slightly better than the performance of children at age 7, the difference is small and not significant. Overall, the data show 7 and 9 year olds to look very much alike. Looking back at Table 3, we can see that this general growth trend toward improved performance with increasing age, particularly between 9 and 11, holds true over all utterance types where improvement is possible, with the exception of Type II-B and Type II-E. We shall consider these deviations from the general trend below in our discussion of particular utterance types.

Table 6 compares the mean scores for utterance types:

Table 6

Comparison of Mean Scores for Utterance Types

	Mean	II-B	II-C	II-D	II-E	II-F	III-G	III-H	IV-I
Mean		0.86	0.84	0.98	0.85	0.48	0.85	0.61	0.92
Type									
I-A	0.99	0.13	0.15	0.01	0.14	0.51*	0.14	0.38*	0.07
II-B	0.86		0.02	-0.12	0.01	0.38*	0.01	0.25*	-0.06
II-C	0.84			-0.14	-0.01	0.36*	-0.01	0.23*	-0.08
II-D	0.98				0.13	0.50*	0.13	0.37*	0.06
II-E	0.85					0.37*	0.00	0.24*	-0.07
II-F	0.48						-0.37*	-0.13	-0.44*
III-G	0.85							0.24*	-0.07
III-H	0.61								-0.31*

Difference required for significance at .05 level: 0.16
Difference required for significance at .01 level: 0.18

*significant at or beyond the .01 level

From Table 6 it can be seen that the two factors that contribute substantially to the overall significance of the F-ratio in Table 4 are Types II-F and III-H (conditionals with "unless," and "ask" plus and minus pronoun). The data show these two types of utterances to be significantly different from all other utterances included in the study.

Table 6 also points up an additional aspect of the data. There are several differences in mean scores that fall just slightly below the absolute value of 0.16 required for signifiance at the 0.05 level (these range between 0.12 and 0.15). All but one of these differences result from comparing the means of Types II-B, II-C, II-E, and III-G with the means of Types I-A and II-D. In other words, there is some indication that limiting contingencies, temporal contingencies, conditionals with "if + not," and utterances with "tell" are different as a group from simple statements and all affirmative conditionals.

All the data obtained from scores can also be depicted in a graph. In Figure 1 the trend in mean scores for each age level is graphed as a function of utterance types, where the latter are arranged in decreasing order of difficulty based on overall means along the horizontal axis. Here one can see how close the performance of 7 and 9 year old children was over all utterance types, as well as how the performance of 11 year old children was substantially better on all but the easiest types and on Type II-B (to be discussed later).

Figure 1 also depicts the significant interaction effect between age and utterance type found in Table 4. In general, a significant interaction effect suggests that the best prediction of a child's performance will depend both upon the

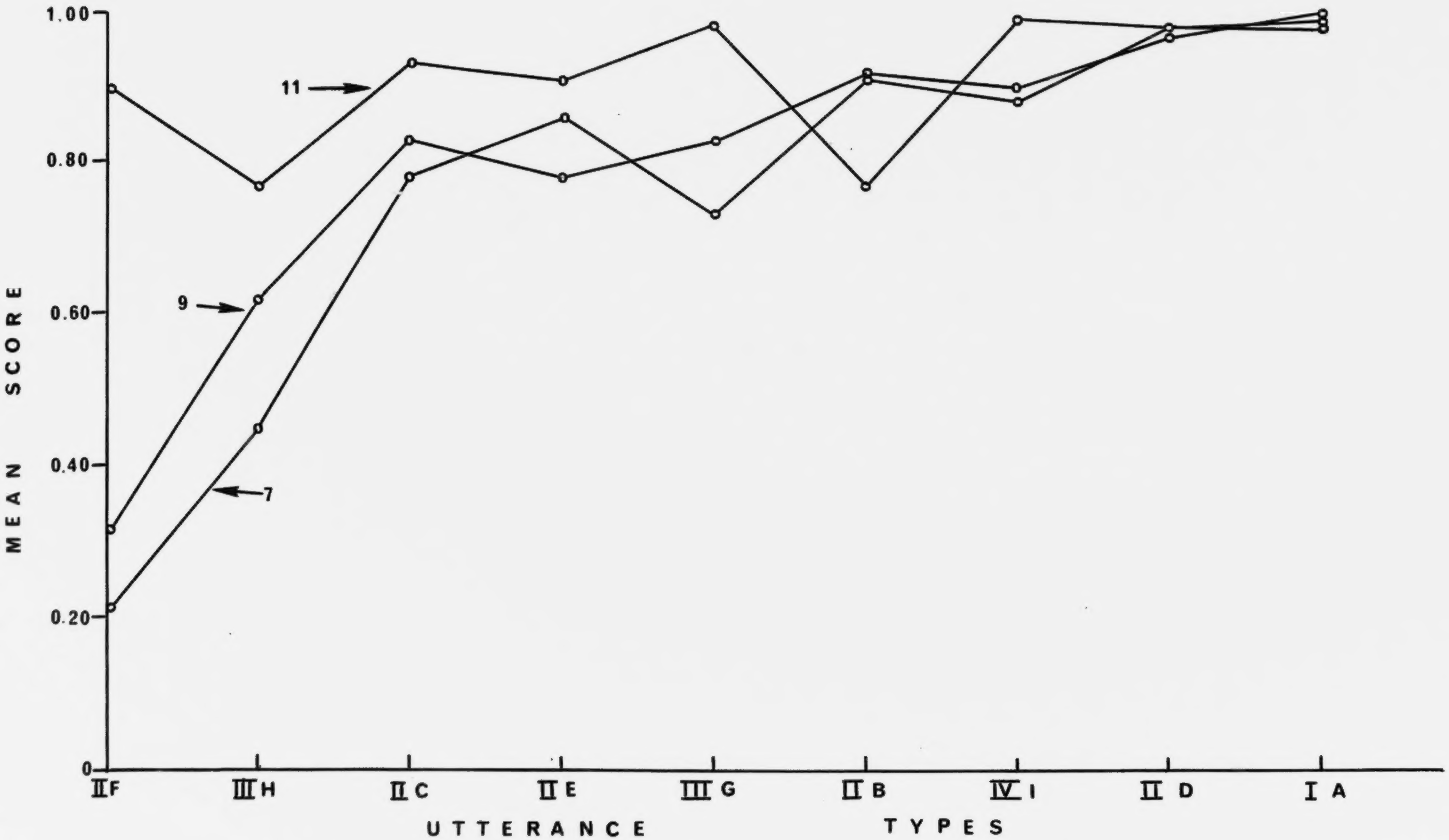

Fig. 1. Mean scores for each age level as a function of utterance types, with utterance types in decreasing order of difficulty (based on overall means).

particular type of utterance and his age level. If no interaction effects were present in the data, the lines representing age levels in Figure 1 would rise progressively without ever dipping, and they would never cross each other. However, as can be seen, the lines do dip at various points as they rise, and they do cross each other at a few points. The dipping is caused by the fact that the overall means for each utterance type are not always the best predictors of performance when one knows the age level of the individuals. For example, while utterances of Type III-H were generally easier than utterances of Type II-F, this was not the case if one is only interested in 11 year olds. The crossing of the lines in Figure 1 is caused by the fact that the overall means for each age level are not always the best predictors of performance on a particular utterance type. For example, while 11 year olds generally performed better than 9 and 7 year olds, this was not the case when one is talking about utterances of Type II-B.

General Analysis - Latencies

To obtain an overall picture of the performance of the children as indicated by their latency scores, the median latencies of the twenty subjects on each utterance type at each age level are reported in Table 7. It can be observed from this table that the younger the child, the higher the latency score (Type II-C being the only exception). It also can be observed that there was a fairly stable order of difficulty among the utterance types across the three age levels (this can be observed more readily in Table 8 and in Figure 2 below).

Table 7

Median Response Latencies for Children on Nine Utterance Types at Three Age Levels

Age	Utterance Type								
	I	II					III		IV
	A	B	C	D	E	F	G	H	I
7	1.20	1.60	2.05	1.65	2.05	2.35	2.80	2.95	1.85
9	0.85	1.30	1.35	1.20	1.60	1.95	1.55	1.30	1.10
11	0.80	1.15	1.40	1.10	1.55	1.60	1.40	1.05	0.90

To test the significance of the effects of age level and utterance type upon latency scores, the Friedman Test for rank ordered data was employed. The data presented in Table 7 was ranked both by age level and by utterance type, and the Friedman analysis was applied to the sum of the ranks in each case. Table 8 presents a summary of this analysis.

On the basis of the ranked median latencies, the three age levels appear to differ significantly, and the nine utterance types also appear to differ significantly. Indeed, the order of difficulty among utterance types as measured by latencies is very similar to the order of difficulty as measured by scores (Spearman Rank Correlation Coefficient = 0.833).

Table 8

Ranks of Median Latencies by Age Level and Utterance Type

Age		Utterance Type									
		I	II					III		IV	Total by Age
		A	B	C	D	E	F	G	H	I	
7	by age	3	3	3	3	3	3	3	3	3	27
	by type	1	2	5.5	3	5.5	7	8	9	4	
9	by age	2	2	1	2	2	2	2	2	2	17
	by type	1	4.5	6	3	8	9	7	4.5	2	
11	by age	1	1	2	1	1	1	1	1	1	10
	by type	1	5	6.5	4	8	9	6.5	3	2	
Total by type		3	11.5	18	10	21.5	25	21.5	16.5	8	

X^2 for difference among rank totals by age = 16.222**, DF: 2

X^2 for difference among rank totals by type = 18.924*, DF: 8

X^2 required at .05, 2 DF: 5.991
X^2 required at .05, 8 DF: 15.507
X^2 required at .01, 2 DF: 9.210
X^2 required at .01, 8 DF: 20.090

* significant at or beyond the .05 level
**significant at or beyond the .01 level

In other words, latencies provide very similar information both about age levels and utterance types to the information provided by scores. Such correspondence between the two measures is reassuring. Therefore, for our analysis of particular utterance types, we shall base our remarks upon the data obtained from scores because they are a more reliable index of performance, but we shall include the data from latencies in our discussion whenever it provides additional or conflicting information.

Before leaving latencies, however, it may be helpful to present the data of Table 7 in a graph (Figure 2) that is similar to our graph for scores (Figure 1). In Figure 2 median latencies for each age level are graphed as a function of utterance type, where the utterance types are arranged in increasing order of difficulty along the horizontal axis. It is interesting to note that Figure 2 shows that the 7 year old group diverged from the closely related general trend set by the 9 and 11 year old groups, whereas in Figure 1 it was the 11 year old group that diverged from the trend followed closely by the 7 and 9 year old group. In addition, the ragged pattern of the line for age 7 in Figure 2 indicates that the order of difficulty for children at this age also diverged from the order of difficulty for older children. In particular, Types III-G and III-H were far more difficult for 7 year olds than would have been predicted from the overall median latencies. We shall discuss possible reasons for this variation below.

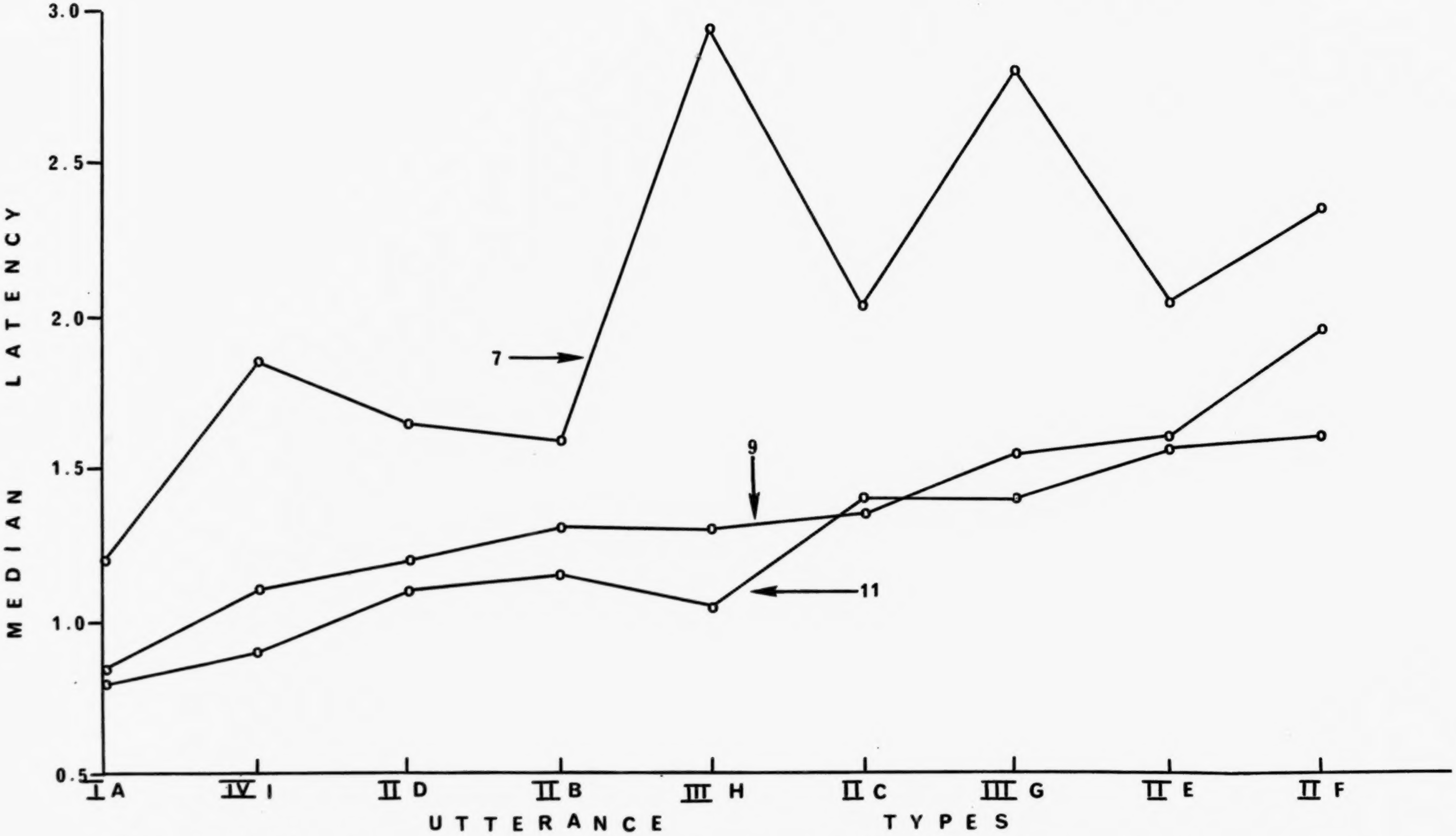

Fig. 2. Median latencies for each age level as a function of utterance types, with utterance types in increasing order of difficulty (based on overall rank order of medians)

Analysis and Discussion of Specific Utterance Types

Type I - Simple Statements. All four varieties of simple statements were grouped within Type I-A. As anticipated, all subjects interpreted these simple instructions correctly and moved their pieces correctly in the game. In a total of 300 moves, only 3 errors were made, giving a percentage error of 1% -- a figure that should be kept in mind as we discuss other types of utterances.

Type II - Logical Connectors. The first group of utterances involving logical connectors (Type II-D) included all conditionals with "if," the subjunctive conditional with "should," and the conditional in question form. Since previous research on language development, especially the work of Piaget (1964), has suggested that children have difficulty with conditional utterances, it was somewhat surprising to find how well all children in this study were able to interpret utterances of this type. In a total of 600 moves, only 14 errors were made, giving a percentage error of 2.3%. While this figure is a little more than twice as large as that for simple statements, it is still very small and clearly indicates that utterances expressing conditionality posed no problem for the subjects in this study.

What few errors there were divided themselves evenly both among the three ages and among the five instruction forms included within this type. It was particularly interesting to find that the subjunctive form with "should" ("Should you have a circle, you may move it one space.") proved to be as easy for the children as the more common forms.

Conditionals with "if + not" (Type II-E) caused considerably more difficulty than affirmative conditionals, most likely because of the presence of the negative. In a total of 240 moves, 36 errors were made, giving a percentage error of 15.0%. While utterances of Type II-E proved to be difficult in comparison with Types I-A and II-D, they were not nearly as difficult as Types II-F and III-H, which we will consider below. It might be said that most children in the age range studied were able to interpret the conditional with negative correctly (only 3 subjects got less than half the items correct), but that the form was sufficiently difficult to cause the children to make mistakes on a slightly more than occasional basis.

Children at each age level had some difficulty with Type II-E, but it is curious that this was the only utterance type on which 9 year old children performed appreciably worse than both 7 and 11 year old children. In fact, 9's made as many errors as 7's and 11's combined. Unfortunately, there does not seem to be any reasonable explanation for this variation in the normal trend toward improved performance with increasing age. But since the total number of errors involved was relatively small and since almost half of the total was accounted for by two subjects, it does not seem to be a variation worth serious concern.

In the context of the game the children played, conditionals with "unless" (Type II-F) were functionally equivalent to conditionals with "if + not" (Type II-E). For example, both the instruction, "Unless you have a square, you may move any piece one space," and the instruction, "If you do not have a square, you may move any piece one space," mean that if the person has a square, he cannot move a piece. Hence, it was anticipated that scores on conditionals with "unless" would be similar to scores on conditionals with "if + not." However, "unless" proved to be far more troublesome than "if + not." Out of a total of 240 moves made in response to "unless" instructions, 126 errors were made, giving a percentage error of 52.5%. Conditionals with "unless" proved to be the most difficult of all types by a substantial margin. Though part of this difficulty may be attributed to the fact that this utterance type again involved interpretation of negative information, the fact that utterances with "unless" proved far more difficult than utterances with "if + not" suggests that another factor was operating here to make "unless" significantly more difficult.

Observations made during the course of the testing helped to provide a clue to the source of the children's difficulty. Often, after a child had made an incorrect move from an instruction with "unless," the experimenter asked the child what the instruction had said. With a high degree of regularity, the child responded, "It said, if you have a square, you may move any piece one space." In other words, the child interpreted "unless" as "if." Since there was no reason to believe that the child did not hear the instruction correctly, it can be argued that in interpreting the instruction, he adapted what he heard to fit what he knew or what was a more familiar construction to him. For a great number of the children tested, "unless " did not appear to be part of their active working repertoire of linguistic tools. It was not the case as with "if + not" that they merely made a number of mistakes, but rather that they were to a substantial extent unable to provide a correct interpretation for the construction.

The above remarks about "unless" must be modified somewhat in light of the data from separate age levels. All but 8 of the total errors were made by 7 and 9 year old children (the errors about equally split between the two ages). This fact is also apparent from Figure 1. In other words, 11 year old children did just as well with "unless" as they did with "if + not," and it was the 7 and 9 year old children who did not seem to have developed an ability to interpret "unless" very well. For example, 15 out of 40 children of age 7 and 9 never interpreted "unless" correctly. Another 16 out of the 40 interpreted it correctly only once in four opportunities. Why it was that 11 year old children understood "unless" quite well, but younger children were unable to interpret it is an intriguing question revealed by, but not easily answered by, this research.

Utterances expressing temporal contingencies (Type II-C) proved to be more difficult than the simple conditionals of Type II-D and about equally as difficult as conditionals with "if + not" (Type II-E). Out of a possible 240 moves, the children made 38 errors, giving a percentage error of 15.8%. All children seemed to understand utterances of this type, regardless of the particular connector employed, but a number of mistakes were made. Since these utterances were the only utterances in the game that required the children to make two distinct moves, it might be argued that they put a somewhat greater load on memory than other utterances. Observations during the games tended to confirm that children often made errors because, after having made one of the two moves, they forgot what the second move was.

Of the four connectors included in Type II-C ("before," "after," "when," and "as soon as") "before" proved to be the most difficult. Since the instruction with "before" was the only one of the four in which chronological sequence was reversed, it probably put even a heavier load upon memory than the other three.

Type II-C showed a typical slight reduction in number of errors with increasing age level. But as was the case with the conditional with "if + not," the reduction in number of errors was not marked enough to suggest any significant difference in ability to interpret this type of utterance across the ages studied. It is reasonable to expect that when an utterance type causes some general difficulty, older children will be better able to interpret the utterance than younger children. The slight improvement with age noted for utterances of Type II-C (and before for utterances of Type II-E) was therefore not remarkable.

The final utterance type included within Type II contained utterances expressing limiting contingencies (Type II-B). Generally, these proved to be of about the same order of difficulty as utterances of Types II-C and II-E, discussed above. Out of 360 moves, the children made 49 errors, giving a percentage error of 13.6%. Though two types of logical connectors were included in Type II-B ("although" and "but") the number of errors on each type was about the same. With the one exception noted below, the children seemed to have had only slight difficulty interpreting utterances of this type. As was the case with utterances of Types II-C and II-E, they made some mistakes, but at no age level was the number of mistakes sufficient to suggest that utterances of this type were not well within their abilities.

Utterances of Type II-B were unique in one respect, however, for they proved to be the only utterances on which 11 year old children scored significantly worse than 7 and 9 year old children. This variation from the normal growth pattern can be seen clearly in Figure 1. Generally speaking, 11's made more than twice as many errors as did the 7's or 9's, and this overall pattern held true for each of the three forms used in the test ("although" initial, "although" final, and "but"). Several times, after observing 11 year old children play the game and make consistent errors on instructions of Type II-B, the experimenter questioned them about the difficulty they were having. From what could be gathered from their remarks, it appeared that many of the 11 year old children were interpreting the instructions in a way very different from the younger children and very different from the experimenter's intention when he included these instructions in the game. Apparently (much to the experimenter's surprise), the 11 year old children managed to detect an ambiguity in the instructions that the experimenter had not anticipated and that the younger children did not readily sense.

To explain this ambiguity, we shall give an exact instruction and then the two possible paraphrases:

> Instruction:
> Although you may not capture a piece on this move, you may move a triangle to any space on the board.
>
> Interpretation A:
> Even though it may not be possible for you to capture a piece on this move, you may move a triangle to any space on the board.
>
> Interpretation B:
> Although you are not permitted to capture a piece on this move, you may move a triangle to any space on the board.

It was anticipated that all subjects would give Interpretation B to the instruction and would respond correctly by moving a triangle to any space on the board without capturing a piece. However, many of the 11 year old children gave Interpretation A to the instruction (a perfectly reasonable interpretation) and therefore both moved the triangle and captured a piece, since a capture was always possible under the conditions of being able to move to any space on the board. Instead of interpreting the subordinate clause in this type of instruction as a limiting contingency or clause of logical discordance, the 11 year old children tended to interpret it as a concessive, which allowed them to capture an additional piece.

This finding is particularly interesting because it indicates how an identical stimulus presented to children under identical conditions may well evoke different responses from different groups of children, depending upon the particular orientation brought to the situation by the child. In this case the 11 year old children proved to have a more richly developed sense of their language than did the younger children, and many of their "errors" were not errors at all but merely a different and completely appropriate interpretation of an ambiguous instruction.

Type III - Ask-Tell. In discussing the two types of utterances included in Type III (Types III-G and III-H), we shall first discuss each type separately and then compare the two types. Type III-G included all the constructions with "tell," both with and without the additional pronoun clue. An error on this type consisted of interpreting the instruction, "Tell your opponent which piece to move one space," to mean, "Ask your opponent which piece to move one space." Out of 180 possible moves, the children made 27 errors, giving a percentage error of 15.0%. In terms of level of difficulty, this percentage error placed Type III-G on the same level with Types II-B, II-C and II-E. If we follow the line of argument used in these latter cases, we would say that the number of errors made on this type suggests that the children were well able to interpret the instructions but that the type was sufficiently difficult to cause a noticeable number of mistakes.

However, the surprising thing about the children's performance on Type III-G was that the instructions should have caused the children any difficulty at all. It had been anticipated that the instruction, "Tell your opponent which piece to move one space," would be totally unambiguous and would therefore be interpreted correctly by virtually all children. It might be reasonable to suggest that some of the errors made by some of the children resulted from a failure to hear distinctly the first word of the instruction, a factor which happens to be critical in this particular case for correct interpretation. But this does not seem to explain the fact that four children (two 7's and two 9's) were not able to interpret any utterance of this type correctly. Since these four subjects accounted for almost half the total number of errors made, explaining their failure to understand might shed some light on why this type of utterance caused difficulty. We shall advance a tentative explanation for this finding after we have considered Type III-H.

As generally expected, scores on Type III-G improved regularly with increasing age, the greatest improvement occurring between the ages of 9 and 11 (11's made only 1 error). More interesting, though, is the finding that the presence of an additional pronominal identification clue did not serve to improve performance significantly, although it did cause a very slight reduction in number of errors. Looking at the performance of individuals, we find that out of 15 subjects who made errors on this utterance type, there were only three for whom the presence of the pronoun clue was helpful.

As anticipated, Type III-H ("ask") proved to be very difficult. When given the instruction, "Ask your opponent which piece to move one space," a large number of the children interpreted it to mean, "Tell your opponent which piece to move one space." Out of 180 possible moves, the children made 70 errors, giving a percentage error of 38.9% and making this type the second most difficult of all those included in this study. As in the case of Type II-F (conditional with "unless"), the very large number of errors made by the children in interpreting this type of utterance suggests that many children in the age range studied had not developed an ability to interpret correctly some particular aspects of their language.

As was true with other utterance types, there was a general decrease in number of errors with increasing age. Of the 36 children who made errors on utterances of this type, 13 failed to respond correctly on all three opportunities. Of these, 8 were 7 years old, 4 were 9 years old, and 1 was 11 years old.

Unlike utterances with "tell," for utterances with "ask" the presence of the additional pronominal clue did prove to be helpful to a number of children. Of the 30 children who failed to interpret the first instruction with "ask" minus pronoun correctly, 16 interpreted a succeeding instruction with "ask" plus pronoun correctly, and 12 of those subjects then interpreted the final instruction (again "ask" minus pronoun) correctly. In other words, in a relatively large number of cases the presence of the pronoun (e.g. "Ask your opponent which piece _you_ should move one space.") helped the children to interpret the instruction correctly.

In comparing Type III-G with Type III-H, it is clear that the children had considerably more difficulty interpreting "ask" than "tell." However, we suggested in Chapter II that only "ask" would cause difficulty because only "ask" is potentially ambiguous. Yet we found both children who interpreted "ask" as "tell" and a few children who interpreted "tell" as "ask." Furthermore, when we look at the scores of individuals, it turns out that all 4 children who consistently interpreted "tell" as "ask" made no mistakes in interpreting "ask," and all 13 children who consistently interpreted "ask" as "tell" made no mistakes in interpreting "tell." These results suggest that the interpretation problem that these utterances raised was not solely a function of the child's ability to interpret the verb "ask" correctly in a given context, but rather a function of a more general failure to differentiate semantically the verb "ask" from the verb "tell."

Given these results, it is also possible to make a suggestion about how the ability to differentiate these two forms develops. At first the child understands "tell" perfectly, but he consistently interprets "ask" also to mean "tell." Secondly, the child develops an understanding of "ask" as "ask." But he overgeneralizes what he has learned so that he now also interprets "tell" as "ask." Finally, he manages to completely differentiate the two forms and is able to interpret them both correctly. Such a developmental process, where learning is over-generalized to cause the child to make errors in situations that previously caused him no difficulty, has been shown to occur in many areas of language development (e.g. Brown and Bellugi, 1964) and is probably characteristic of other types of development as well.

As we have seen, when additional structural clues were kept to a minimum so that interpretation was almost totally dependent upon whether or not the child semantically differentiated the two verbs, we found that many children could not provide the correct interpretation. When additional structural clues were provided, interpretation was facilitated to some degree, but there still remained a substantial number of children for whom even the additional structural information was not helpful. Out of the 60 children tested, 17 fell into this group (10 of the 7's, 6 of the 9's, and only 1 of the 11's). A reasonable hypothesis might be that these 17 children were less mature verbally than the other children tested.

One way of checking this hypothesis is to see how these 17 children performed on utterances of Type II-F (conditional with "unless") since our analysis of that type also revealed serious interpretive difficulties on the part of the children. It turns out that 9 out of the 17 were not able to interpret a single instruction of Type II-F correctly, and only 3 of the 17 interpreted more than one correctly. In fact, looking at the data individual by individual, a child who scored low on either Type III-G or III-H also tended to score low on Type II-F. This is not to argue that there exists any relationship between these two types as grammatical forms. However, it may be the case that these two forms reflect two distinct and significant aspects of the development of language between the ages of 6 and 12.

The data obtained from latencies add one further piece of information to the "ask-tell" puzzle. As can be readily seen from Figure 2, utterances with "ask" and "tell" caused substantially greater latencies from 7 year old children than any other type of utterance. This was not true for either 9 or 11 year old children. Therefore, not only does this finding provide some support for our hypothesis that ability to differentiate "ask" from "tell" is a significant indicator of language development, but it also adds further support to our hypothesis that interpretation of the two forms is closely related, since not one but both forms produced relatively high latencies from 7 year old children.

Type IV - Embeddings. Utterances containing embeddings (Type IV-I) were found to be considerably easier to interpret than had been anticipated by the experimenter in light of the research of Fodor and Garrett discussed in Chapter II. In fact, these utterances turned out to be the third easiest overall, a little more difficult than Type I-A (simple statements) and Type II-D (conditionals with "if") but considerably easier than all other types. Out of 360 possible moves, only 27 errors were made, giving a percentage error of 7.5%. It seems quite apparent that single level embeddings of the kind used in this study posed very little comprehension difficulty for children within the age range of 6 to 12.

Even though the total number of errors on this type over all subjects was very low, it is worth pointing out that most of the errors were made by the 7 and 9 year old children and that the 11 year old children performed almost perfectly (only 1 error).

One of the major reasons for including embedded utterances of this type in the study was to see if the presence of a relative pronoun would facilitate understanding (see the discussion in Chapter II). However, the utterances proved to be of so little difficulty that comparisons between instances with and without the relative pronoun are not very informative. Contrary to prediction, utterances with the relative present caused slightly *more* errors than utterances without the relative (15 errors versus 12). This trend was certainly not significant, but it did run counter to the hypothesis that presence of the relative should have proved helpful in interpretation.

The data obtained from the response latencies do, however, add some further information to our comparison of utterances with and without the relative pronoun. Though according to this measure Type IV-I still proved to be one of the easiest, there was a fairly large difference in median response latencies (0.4 seconds) between plus and minus relative conditions. In this case the difference was in favor of those utterances with the relative present. In other words, on the average, subjects took about half a second less time to respond to embedded sentences with the relative present than they took to respond to embedded sentences without the relative.

Thus we find that the latency data but not the score data tend to support the Fodor and Garrett hypothesis that the presence of a relative pronoun in self-embedded sentences is a structural clue that facilitates interpretation. Though Fodor and Garrett (1967) did have to compute a score that was a composite of a correctness measure and a latency measure to obtain significant results in their study, both of their measures tended in the hypothesized direction for all their subjects, whereas one of our measures tended in the opposite direction. Perhaps, if we had somehow been able to make our self-embedded sentences more difficult generally, without going to the extreme of using the exceptionally difficult double self-embedded sentences used by Fodor and Garrett, our results would have been more informative.[1]

Analysis of Secondary Effects

We have already noted at the beginning of this chapter that the fact that an individual was Player A or Player B of each pair of children playing the game did not appear to be a factor influencing the overall performance of the subjects. Another independent variable that might have produced some secondary effects was the position of the subordinate clause relative to the main clause in many of the utterances. As noted in Chapter II, subordinate clauses were placed in both initial and final positions wherever possible in order to vary the nature of the instructions and also to see if the positioning of the subordinate clause was a factor influencing interpretation.

---

[1] In a study of children's ability to paraphrase single self-embedded sentences, A. Olds (in preparation) has devised a means of significantly complicating such sentences. She has added a relative clause to the embedded clause to give sentences of the form, "The dog that the cat that chased the rat fought ran away." Her preliminary results show such forms to be relatively difficult for children, age 6 to 12, but not totally beyond their ability to understand.

A comparison of all instructions having the subordinate clause in initial position with all instructions having the subordinate clause in final position showed a very slight and highly insignificant difference in favor of those instructions with the subordinate clause in final position (e.g. "You may move a square one space if you have a circle."). Nor were any obvious differences found on any individual utterance type. The ordering of clauses, therefore, did not seem to be a factor influencing interpretation in this particular experimental context.

In the remainder of this section we shall consider the two closely related matters of whether or not there was a learning effect during the course of the game and whether or not there is reason to believe that the performance of one player influenced the performance of the other.

Learning Effects. A learning effect during the course of the game might be claimed if it could be shown that the performance of individuals on specific utterance types improved with successive instructions of the same type. Since the performance of the children on Types I-A, II-D, and IV-I was extremely good, there was little point in including these types in the analysis. Furthermore, since the children received only one chance to interpret each of the four kinds of instructions included in Type II-C, it was not possible to include this type in the analysis. On all five of the other types it was possible to try to assess improved performance because in all cases an instruction occurring early in the game could be compared with an identical instruction occurring much later in the game. Therefore, on Types II-B, II-E, II-F, III-G, and III-H each individual's first response was compared with his last response, and the mean of the differences was found for each type. The significance of the mean differences was found by applying a t-test for paired observations as described in Hays (1963). The results of this analysis are summarized in Table 9.

The analysis in Table 9 shows that for three types of utterances there was an improvement over all subjects between the first and last instances of each type that was significantly greater than zero. However, on Types III-G and III-H improvement was not significant. In other words, children did learn during the course of the game on the utterances where learning was possible, but certain utterances were learned more readily than others. This learning effect might be explained in part by suggesting that improvement in a child's performance was attributable to his becoming more familiar with the game as it progressed. In the early stages of the game he might have found the wide variety of different instructions somewhat confusing, but as the game progressed and he became

Table 9

Comparison of Mean Differences Between First and Last Instances of Five Utterance Types

	Utterance Type				
	B	E	F	G	H
Mean Difference	0.167	0.183	0.283	-0.017	0.117
Standard Deviation	0.553	0.429	0.580	0.387	0.551
t	2.339*	2.542**	3.779**	-0.236	1.645

t required at .05, 59 DF: 1.671 (one tailed)
t required at .01, 59 DF: 2.390 (one tailed)

* significant at or beyond the .05 level
** significant at or beyond the .01 level

accustomed to playing, his performance may have improved. However, observations of the children playing the game suggested that while this explanation may be partly true, a more plausible explanation of how learning occurred can be made on the basis of the influence one player had on the other.

The Nature of Influence. As we argued in Chapter II, the best case for claiming influence of one player upon the other in the game used in this study can be made by pointing out that it was often the case that one player made an error and was subsequently corrected by his opponent. This is not to say that the players didn't influence each other in other more subtle ways during the course of the game. But it is extremely difficult to explain what these other ways might have been or to assess their effects. Therefore, rather than speculate on imponderables, we shall devote our attention solely to discussing the one situation where influence was clearly operating.

Though it might have been possible to attempt to prohibit one player from correcting another during the course of the game, such prohibition would have been extremely artificial and probably ineffective, since it would have been very difficult to restrain the natural reactions of excited and interested children. Therefore, it was decided that since the children would react to each other anyway, it would be better to encourage them to verbalize their reactions to each other's responses and in this way gain additional information on the extent of their understanding of the various utterances and on their ability to communicate their understanding to another person. In a sense, allowing the children to talk about the instructions provided some production data to support the comprehension data that constituted the major focus of the study.

Generally speaking, as might be expected, the extent to which one player was able to influence the behavior of another player depended upon the extent to which the player who understood a particular instruction could explain to the player who made an error why the latter had misinterpreted the instruction. We noted above that there was a significant learning effect for three types of utterances (Type II-B, Type II-E, and Type II-F). Both the observations and the recorded transcripts of the children playing the game indicated that it was precisely on these three types that some children were best able to point out and explain errors to other children. Let us take Type II-F as a case in point, for it was the most difficult type included in the game, and it also showed the greatest learning effect during the course of the game.

We noted above in our discussion of Type II-F that most of the children who failed to interpret the instructions correctly seemed to be interpreting "unless" to mean "if," and when they were asked by the experimenter to repeat the instruction, they responded that the instruction had said, "If you have . . . " One child's correction of another child in this case generally consisted of pointing out to the child who had made the error that the instruction had said "unless," not "if," and that the two meant entirely opposite things. The following are two examples from the recorded transcripts:

A - (Moves incorrectly)
B - "That's wrong, cause it said unless you have a large piece, you may move a circle."
A - "If you have a large piece, you may move a circle."
B - "If you do not have a large piece you may move a circle. You have a large piece. You can't move."
E - "That's right, he can't move."

B - (Moves incorrectly)
A - "No. No. Cause you have one large piece. You got a large piece, so you can't move."
B - "It said if I have a large piece."
A - "No, it said unless you have a large piece."

Two types of utterances (Types III-G and III-H), analyzed in Table 9, showed virtually no learning effect over the course of the game. It was very clear from observations and from the recorded transcripts that children also found it almost impossible on these two types of instructions to explain to each other why a mistake had been made. The following examples from the transcripts show the difficulty in communication that arose with these instructions:

B - (Hears instruction, "Ask your opponent . . . ")
B - "I have to ask? Move . . . "
A - "You ask me. No, you ask me."
B - "That is mine #15. Ask him to show him which space to move it. So move that there."
A - "I don't think so. I think I was supposed to tell him."
E - "That's right."
(A then tells B and B moves, but B is clearly confused.)

A - (Hears instruction, "Ask your opponent . . . ")
B - "You ask me. Ask which piece should I move . . . go ahead."
A - "Move this triangle there."
B - "It said ask me."
A - "Please ask . . . Please move your triangle there."
B - "No."
A - "He said which . . . it said to . . . which piece . . . it said to ask your opponent to move a piece, for him to move."
B - "I don't think it did."

Differentiation of the semantic distinction between "tell" and "ask" was far less amenable to verbal explanation than was the distinction between "unless" and "if." This finding suggests that the "ask-tell" distinction may be a more integral part of a larger semantic system that is developing in the child and that is not very susceptible to conscious alteration. The "unless-if" distinction, on the other hand, may exist outside of the overall development of the language system, as an artifact of conceptual development, and may therefore be more easily changed through conscious effort and instruction.

While the influence we have discussed operated as an uncontrolled variable in the experimental situation (probably along with other uncontrolled variables) and therefore made the experimental design a bit noisier than is generally considered desirable, its overall impact was to reduce the magnitude of any measured differences. Clearly, had we chosen to analyze only the children's initial responses to instructions from each type of utterance, or if we had somehow been able to eliminate all sources of influence, then the learning effect would have been either eliminated or substantially diminished, and the observed differences would have been greater on all measures. However, even allowing players to influence one another, we were able to observe significant differences in performance, and we were also able to observe how interaction effected the learning of particular utterance types. Thus, the method used succeeded in providing considerable information without, at the same time, adding too much extraneous confusion.

Observations and Impressions

The game used as the testing instrument in this study worked as well as the experimenter had anticipated on the basis of previous experience. The children thoroughly enjoyed playing the game, were disappointed when it was over, and were constantly asking the experimenter and his assistant if they could come play the game again. As best could be judged from watching them play, the children's level of engagement with the game was extremely high, and their performance always seemed to be a valid indication of their abilities.

The most overwhelming impression after watching 60 children play the game, an impression that is easily forgotten in the course of focusing upon the children's errors, was the surprisingly high level of performance that all children exhibited in playing the game. Given the conditions that none of the children had ever played the game before, that they were asked to respond successively to 45 instructions of a wide variety of types, and that they were never allowed to listen to an instruction twice, their overall performance was remarkably good,and they showed an excellent command of most of the utterances employed in the game.

Such well developed capabilities on the part of the children studied would not have been predicted either on the basis of previous research or on the basis of teachers' evaluations of children's language development. For example, as noted in Chapter I, studies of children's productions invariably point out that children between the ages of 6 and 12 use logical connectors very infrequently. Piaget's studies of elicited productions would lead one to believe that it is not until at least 11 years of age that logical connectors are well understood by children. And teachers of young children are constantly suggesting that constructions of the types included in this study must be taught to children because they do not understand them. The only construction included in this study on which children's performance was poor and which seemed amenable to instruction was the negative conditional with "unless." And by the time the child is 11 years old, it would appear that it is no longer a problem. Though it is possible that the children studied had received some formal instruction in the use of "unless" between the ages of 9 and 11, it is more likely that they learned to understand the form as part of their normal intellectual growth.

There was a considerable amount of verbalization on the part of the children while they were playing the game. But there were some very distinct differences in both the extent and the quality of this verbalization among the three age levels studied. A large number of the 7 year old children talked continually during the course of the game, so much so that the experimenter often had to caution them to be quiet while their opponent was listening to his instruction. While much of the talk took the form of aggressive banter (e.g. "You got one of my men, but I'm going to get you next time and then I'll really kill you."), these 7 year old children also frequently repeated instructions to themselves as they contemplated how to move. However, despite their high level of verbalization as they played the game, the 7 year old children rarely communicated with each other. Most of their talk had the distinct quality of talking out loud to oneself, very like the egocentric talk that Piaget has described.

A rough quantitative index of the amount of verbalization at the three age levels can be given from the mean number of instructions that evoked some verbal comment. On the average, 7 year olds responded verbally to 23 of the 45 instructions, but because they were talking almost incessantly, this is a very low estimate of their verbal activity. By comparison, the 9 year olds responded verbally to 18 instructions on the average, and the 11 year olds responded to 15. Since the 9 and 11 year old children tended to confine their talk more to matters relevant to the playing of the game, these indexes are a more accurate picture of the extent of their verbal activity than is true for the 7 year olds.

Though the 9 and 11 year old children talked considerably less while playing the game, a much greater amount of their verbalization consisted of real communication, either with their opponent or with the experimenter. They did not talk to themselves, and they did not constantly repeat instructions out loud or subvocally as did the 7 year olds. The 11 year olds were particularly quiet as they played, talking only when there was some need actually to communicate with another person.

Though this particular observation is not directly related to the structure of the children's language, the experimenter found the amount of aggressiveness and hostility that the 7 year old children expressed toward each other remarkable. Certainly there was little if any seriousness in the constant threats they made to "kill" or "smash" each other, and the competitive nature of the game undoubtedly contributed to encouraging such interchange. But interchange of hostilities was often the closest the 7's came to engaging in a dialogue. "I'm going to kill you next time." "No you won't, cause I'm going to wipe you out." Perhaps one of the ways 7 year old children learn to talk to each other is through such ritualized language play.

Conclusion

The nine types of utterances explored in this study over three age levels seemed to fall into three distinct groups in terms of their relative difficulty for the children tested. Three types were so fully within the capabilities of the children that they were interpreted correctly in virtually every instance. This first group included simple statements, affirmative conditionals of various kinds, and single embedded sentences. The second group of utterance types, including limiting contingencies with "although" and "but," various temporal contingencies, and negative conditionals with "if + not," was difficult enough to cause the children to make some mistakes, but the children performed well enough to show a well developed capacity for interpreting all types in the group. Within this group, performance improved with age, and there was strong indication of improvement in performance during the course of the game. The third group, composed of the "ask-tell" combination and negative conditionals with "unless," caused such a high level of difficulty, particularly for 7 and 9 year old children, that it seems reasonable to suggest that many children have not developed an ability to interpret these forms until about age 11, and even then, some have difficulty. At all age levels performance on "unless" improved during the course of the game, aided in part by the interaction of children as they played, but there was little improvement on the "ask-tell" distinction.

Thus, it seems likely that we may have touched upon two distinct aspects of language development during this period in a child's life, both of which merit considerably more attention than they have been given in past research and much more thorough study than was possible here. On the one hand, it appears that the child between the ages of 6 and 12 is learning how to understand and use effectively a relatively small set of special signaling devices, of which the logical connectors like "unless" form a major part. Many of these signals are learned early and cause the child little difficulty (e.g. "if"). Others (e.g. "unless") are learned relatively later in the child's development. And some (e.g. "although") have more than one meaning and are learned first in one sense and later in both senses. All of these special signaling devices probably function largely as aids to communication, not as integral components of the language system without which communication would be seriously impaired. As such, it is at least possible that these forms are learned as special lexical items with special meanings and functions. They tend to appear later in the child's verbal repertoire than other components of the language system, and their effective use seems to develop concomitantly with growth in related cognitive skills. Since proper understanding of these forms, like the understanding of complex logical relationships, seems a highly conscious process, learning may well be enhanced by appropriate forms of instruction.

At the same time that a child's ability to understand and use these special signaling devices is developing, his semantic system is gradually becoming fully developed. Though we know very little about the nature or the process of development of semantic systems, it seems reasonably clear that while the basic aspects of a semantic system must be learned early in a child's life along with the basic syntactic system of the language, a fully developed and fully differentiated semantic system must await the acquisition of a sufficient number and array of lexical items. Though the evidence from this study is merely suggestive, it seems reasonable to propose that the difficulties the younger children had with the "ask-tell" utterances were semantic in nature, particularly in light of the finding that additional structural clues were only slightly helpful. Therefore, ability to make such differentiations as that required for interpretation of the "ask-tell" distinction may be hypothesized to be a function of a developing semantic system, just as is probably the case with the child's ability to properly interpret reversible passive sentences (see the discussion in Chapter II). As such, it is not likely that the learning of semantic differentiations will benefit as much from direct instruction as from a more general attempt to enrich the child's lexical repertoire.

This study sampled only a very small range of language phenomena among a homogeneous "normal" population of children. While the particular game used in this study placed limits upon the range of utterance types that could be effectively studied, the underlying idea of using such a context for language research appears to be worth extending to similar games that could be used to explore a wide range of language abilities. The present game, and modifications of it, might also be used to compare verbal development across socio-economic groups. Experience that the author has already had in playing the game with lower class children suggests that their performance on many of the nine types of utterances would fall considerably below that of their middle class peers.

Many of the secondary effects noted in the course of this study suggest the potential value of such a language game as an instructional device. Children enjoy playing it, they seem to learn by playing it, it stimulates verbal interaction, and it can be suitably modified by teacher or by student to suit the needs and interests of students at any particular point in their growth. Furthermore, appropriate use of the game creates a natural and stimulating learning situation in which children work with children and jointly help each other to grow.

APPENDIX A

GAME INSTRUCTIONS: PLAYERS A AND B

Game Instructions - Player A

1. You may move a circle one space.
2. You may move a square two spaces.
3. You may move a diamond one space.
4. If you have a circle, you may move it one space.
5. If you have a diamond, you may move a triangle one space.
6. You may move a square one space if you have a circle.
7. After you move a triangle one space, you may move a square one space.
8. Tell your opponent which piece to move one space.
9. Before you move a diamond one space, you must move a circle one space.
10. As soon as you have moved a circle one space, you may move a triangle one space.
11. When you have moved a triangle one space, you may move a circle one space.
12. If you have a square, you may move it one space.
13. The piece your opponent just moved may be moved two spaces backwards.
14. Ask your opponent which piece to move one space.
15. Although you may not capture a piece on this move, you may move a triangle to any space on the board.
16. You may move a triangle two spaces, but you may not capture a piece on this move.

17. If you have a large piece, you may move it one space.
18. You may move either a circle or a diamond one space.
19. If you do not have a large piece, you may move a circle one space.
20. Should you have a circle, you may move it one space.
21. You may move any piece two spaces, but you may not capture a piece on this move.
22. You may move a triangle one space if you have a square.
23. The piece that your opponent just moved may be moved backward one space.
24. You may move a circle two spaces unless you have a large piece.
25. Ask your opponent which piece you should move one space.
26. Any piece that your opponent has captured may be put back on any open space on the board.
27. You may move a square to any space on the board, although you may not capture a piece on this move.
28. If you have a diamond, you may move a circle one space.
29. Tell your opponent which piece he should move one space.
30. You may move a square one space if you do not have a circle.
31. Unless you have a large piece, you may move any piece two spaces.
32. You may move any piece one space if you do not have a square.
33. Do you have a large piece? Then you may move it one space.
34. Tell your opponent which piece to move two spaces.
35. Although you may not capture a piece on this move, you may move any piece to any space on the board.
36. Should you have a triangle, you may move it one space.
37. Any piece your opponent has captured may be put back on any open space on the board.

38. Unless you have a circle, you may move any piece one space.

39. The piece your opponent just moved may be captured by a diamond.

40. If you do not have a square, you may move any piece one space.

41. You may move any piece one space unless you have a triangle.

42. Ask your opponent which piece to move one space.

43. You may move a piece to any space on the board although you may not capture a piece on this move.

44. The piece that your opponent just moved may be captured by a square.

45. Move any piece to any space on the board.

Game Instructions - Player B

1. You may move a diamond one space.
2. You may move a triangle two spaces.
3. You may move a circle one space.
4. After you move a square one space, you may move a diamond one space.
5. When you have moved a triangle one space, you may move a diamond one space.
6. As soon as you have moved a circle one space, you may move a square one space.
7. Before you move a circle one space, you must move a triangle one space.
8. If you have a square, you may move it one space.
9. You may move a triangle one space if you have a diamond.
10. If you have a circle, you may move a square one space.
11. Although you may not capture a piece on this move, you may move a diamond to any space on the board.
12. You may move either a square or a circle one space.
13. If you have a diamond, you may move it one space.
14. The piece your opponent just moved may be moved two spaces backwards.
15. Ask your opponent which piece to move one space.
16. Tell your opponent which piece to move one space.
17. Should you have a square, you may move it one space.
18. You may move a square two spaces, but you may not capture a piece on this move.
19. If you have a large piece, you may move it one space.

20. If you do not have a large piece, you may move a diamond one space.

21. The piece that your opponent just moved may be moved backward one space.

22. If you have a circle, you may move a square one space.

23. Unless you have a large piece, you may move any piece two spaces.

24. You may move a triangle to any space on the board although you may not capture a piece on this move.

25. You may move a circle one space if you have a diamond.

26. Tell your opponent which piece he should move one space.

27. You may move any piece two spaces, but you may not capture a piece on this move.

28. Any piece that your opponent has captured may be put back on any open space on the board.

29. You may move a square two spaces unless you have a large piece.

30. Ask your opponent which piece you should move one space.

31. Do you have a large piece? Then you may move it one space.

32. Any piece your opponent has captured may be put back on any open space on the board.

33. You may move a diamond one space if you do not have a triangle.

34. Unless you have a circle, you may move any piece one space.

35. Tell your opponent which piece to move two spaces.

36. If you do not have a diamond, you may move any piece one space.

37. Ask your opponent which piece to move one space.

38. Although you may not capture a piece on this move, you may move any piece to any space on the board.

39. Should you have a circle, you may move it one space.

40. You may move any piece one space if you do not have a diamond.

41. You may move a piece to any space on the board although you may not capture a piece on this move.

42. The piece your opponent just moved may be captured by a triangle.

43. You may move any piece one space unless you have a square.

44. Move any piece to any space on the board.

45. The piece that your opponent just moved may be captured by a circle.

REFERENCES

Attribute Games and Problems. Preliminary Edition. Newton, Massachusetts: Educational Services, Inc., 1965.

Bellugi, U. The acquisition of negation. Unpublished Ed. D. thesis, Harvard Graduate School of Education, 1967.

Berko, J. The child's learning of English morphology. In Saporta, S. (Ed.), Psycholinguistics. New York: Holt, Rinehart and Winston, 1961.

Bernstein, B. Social class and linguistic development: a theory of social learning. In Halsey, A. H., Floud, J., and Anderson, C. A. (Eds.), Education, economy, and society. New York: The Free Press of Glencoe, 1961.

__________. The role of speech in the development and transmission of culture. In Klopf, G. J. and Hohman, W. A. (Eds.), Perspectives on learning: papers from the Bank Street fiftieth anniversary invitational symposium. New York: Bank Street College of Education, 1967.

Braine, M. D. S. The ontogeny of English phrase structure: the first phase. Language, 1963, 39, 1-13.

Brown, R. and Bellugi, U. Three processes in the child's acquisition of syntax. Harvard Educational Review, 1964, 34, 133-151.

__________ and Fraser, C. The acquisition of syntax. In Cofer, C. N. and Musgrave, B. (Eds.), Verbal behavior and learning: problems and processes. New York: McGraw-Hill, 1963.

Carroll, J. B. Language development in children. In Saporta, S. (Ed.), Psycholinguistics. New York: Holt, Rinehart and Winston, 1961.

Cazden, C. On individual differences in language competence and performance. The Journal of Special Education, 1966-67, 1, 135-150.

__________. The acquisition of noun and verb inflections. Paper presented at the biennial meeting of the Society for Research in Child Development, New York City, March, 1967.

Chomsky, C. The acquisition of syntax in children from five to ten. Unpublished Ph.D. thesis, Harvard University, 1968.

Chomsky, N. Syntactic structures. The Hague, Netherlands: Mouton, 1957.

__________. A review of B. F. Skinner's Verbal Behavior. Language, 1959, 35, 26-58.

__________. Formal discussion of Miller, W. and Ervin S. The development of grammar in child language. In Bellugi, U. and Brown, R. (Eds.), The acquisition of language. Monographs of the society for research in child development, 1964, 29, 35-39.

__________. Aspects of the theory of syntax. Cambridge: The M.I.T. Press, 1965.

__________. Remarks on nominalization. In Jacobs, R. and Rosenbaum, P. (Eds.), Readings in English transformational grammar. (in press)

Clifton, C., Kurcz, I., and Jenkins, J. Grammatical relations as determinants of sentence similarity. J. verb. Learn. verb. Behavior, 1965, 4, 112-117.

Curme, G. O. English grammar. New York: Barnes & Noble, 1947.

Davis, E. A. Developmental changes in the distribution of parts of speech. Child Develpm., 1938, 9, 309-317.

Edwards, A. L. Expected values of discrete random variables and elementary statistics. New York: Wiley, 1964.

Fodor, J. and Garrett, M. Some reflections on competence and performance. In Lyons, J. and Wales, R. J. (Eds.), Psycholinguistics papers. Edinburgh: University Press, 1966.

__________ and Garrett, M. Some syntactic determinants of sentential complexity. Perception & Psychophysics, 1967, 2, 289-296.

__________,Garrett, M., and Bever, T. G. Some syntactic determinants of sentential complexity, II: verb structure. Mimeo., 1967.

Fraser, C., Bellugi, U., and Brown, R. Control of grammar in imitation, comprehension, and production. J. verb. Learn. verb. Behavior, 1963, 2, 121-135.

Glanzer, M. and Clark, W. H. Accuracy of perceptual recall: an analysis of organization. *J. verb. Learn. verb. Behavior*, 1963(a), *1*, 289-299.

__________. The verbal loop hypothesis: binary numbers. *J. verb. Learn. verb. Behavior,* 1963(b), *2*, 301-309.

Gotkin, L. G. Language lotto. New York: Appleton-Century-Crofts, 1966.

__________. Matrix games. New York: Appleton-Century-Crofts, 1967.

Gough, P. B. Grammatical transformations and speed of understanding. *J. verb. Learn. verb. Behavior*, 1965, *4*, 107-111.

Harrell, L. E. A comparison of the development of oral and written language in school-age children. *Monographs of the society for research in child development*, 1957, *22*.

Hays, W. L. *Statistics for psychologists*. New York: Holt, Rinehart and Winston, 1963.

Hunt, K. W. *Grammatical structures written at three grade levels*. Champaign, Illinois: National Council of Teachers of English, 1965.

LaBrant, L. A study of certain language developments of children in grades 4-12 inclusive. *Genet. Psychol. Monogr.*, 1933, *14*, 387-491.

Lees, R. Formal discussion of Brown, R. and Fraser, C. The acquisition of syntax. In Bellugi, U. and Brown, R. (Eds.), *The acquisition of language. Monographs of the society for research in child development*, 1964, *29*, 92-98.

Linguistic block series. New York: Scott-Foresman, 1963.

Loban, W. D. *The language of elementary school children.* Champaign, Illinois: National Council of Teachers of English, 1963.

__________. *Language ability, grades seven, eight, and nine*. Cooperative Research Monograph No. 18. Washington, D.C.: Office of Education, 1966.

Luria, A. R. Experimental analysis of the development of voluntary action in children. *The central nervous system and behavior: selected translations from the Russian medical literature*. Washington, D.C.: Department of Health, Education, and Welfare, Public Health Service, 1959(a).

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Luria, A. R. The role of speech in child development. The central nervous system and behavior: selected translations from the Russian medical literature. Washington, D.C.: Department of Health, Education, and Welfare, Public Health Service, 1959(b).

Marshall, J. C. Behavioural concomitants of linguistic complexity. Unpublished monograph, 1964.

Mehler, J. Some effects of grammatical transformations on the recall of English sentences. J. verb. Learn. verb. Behavior, 1963, 2, 346-351.

__________ and Bever, T. G. Cognitive capacity of very young children. Science, 1967, 158, 141-142.

Menyuk, P. Syntactic rules used by children from preschool through first grade. J. Child Develpm., 1963(a), 34, 533-546.

__________. A preliminary evaluation of grammatical capacity in children. J. verb. Learn. verb. Behavior, 1963(b), 2, 429-439.

Miller, G. A. The magical number seven, plus or minus two: some limits on our capacity for processing information. Psychological Review, 1956, 63, 81-97.

__________. Some psychological studies of grammar. American Psychologist, 1962, 17, 748-762.

__________. The psycholinguists: on the new scientists of language. Encounter, 1964, 23, 29-37.

__________ and Isard, S. Some perceptual consequences of linguistic rules. J. verb. Learn. verb. Behavior, 1963, 2, 217-228.

Miller, W. and Ervin, S. The development of grammer in child language. In Bellugi, U. and Brown, R. (Eds.), The acquisition of language. Monographs of the society for research in child development, 1964, 29, 9-34.

McCarthy, D. Language development in children. In Carmichael, L. (Ed.), Manual of child psychology. New York: Wiley & Sons, 1946.

O'Donnell, R. C., Griffin, W. J., and Norris, R. C. Syntax of kindergarten and elementary school children: a transformational analysis. Champaign, Illinois: National Council of Teachers of English, 1967.

Piaget, J. The language and thought of the child. New York: Meridian Books, 1955.

__________. Judgment and reasoning in the child. Paterson, New Jersey: Littlefield, Adams, 1964.

Rosenbaum, P. S. The grammar of English predicate complement constructions. Cambridge: The M.I.T. Press, 1967.

Rui, A. A pilot study of children's use of conjunctions. Mimeo., 1966.

__________. A socio-linguistic study of children's ability to transform sentences. Talk presented to the School Language Group, Harvard Graduate School of Education, 1967.

Savin, H. B. and Perchonock, E. Grammatical structure and the immediate recall of English sentences. J. verb. Learn. verb. Behavior, 1965, 4, 348-353.

Sinclair, H. Langage et operations. Paris: Dunod, 1967.

Skinner, B. F. Verbal behavior. New York: Appleton-Century-Crofts, 1957.

Slobin, D. I. Grammatical transformations and sentence comprehension in childhood and adulthood. J. verb. Learn. verb. Behavior, 1966, 5, 219-227.

__________ and Welsh, C. A. Elicited imitation as a research tool in developmental psycholinguistics. Mimeo., 1967.

Smith, C. A study of young children's comprehension. Talk presented to the M.I.T. Linguistics Club, 1966.

Smith, D. V. Growth in language power as related to child development. NSSE Yearbook, 1944, 43 (II), 52-97.

Strickland, R. G. The language of elementary school children: its relationship to the language of reading textbooks and the quality of reading of selected children. Bulletin of the School of Education, 38. Bloomington, Indiana: Indiana University, 1962.

Templin, M. C. Certain language skills in children. Minneapolis: University of Minnesota Press, 1957.

Vygotsky, L. S. Thought and language. Cambridge: The M.I.T. Press and John Wiley, 1962.

Wason, P. C. The processing of positive and negative information. Quart. J. Exp. Psychol., 1959, 11, 92-107.

Wason, P. C. Response to affirmative and negative binary statements. Brit. J. Psychol., 1961, 52, 133-142.

Watts, A. F. The language and mental development of children. London: George Harrap, 1944.

Weathersby, R. Describing patterns of connector use. A working paper submitted to the School Language Group, Harvard Graduate School of Education, 1967.

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